GASTICAP

Version 2.0

User Guide

RUTGERS
Edward J. Bloustein School of Planning and Public Policy
GASCAP was developed by the Alan M. Voorhees Transportation Center at Rutgers University under contract to the New Jersey Department of Transportation (NJDOT). This software is freely available to use for all purposes associated with estimating greenhouse gas emissions for transportation capital projects. Any modifications or updates made to GASCAP must also be for public use and the product and any modifications to. GASCAP may not be sold for commercial use.
Contents

Contents.................................................................................................................................................................. 3
Introduction ............................................................................................................................................................ 4
Enabling Macros...................................................................................................................................................... 5
Project Info .............................................................................................................................................................. 6
Section 1: Materials................................................................................................................................................. 7
Section 2: Equipment .............................................................................................................................................. 9
Section 3: Recyclables........................................................................................................................................... 14
Section 4: Lifecycle Maintenance .......................................................................................................................... 15
Section 5a: Staging ................................................................................................................................................ 17
Section 5b: Traffic Disruption ................................................................................................................................ 19
Section 6: Lighting ................................................................................................................................................. 24
Section 7: Rail ........................................................................................................................................................ 25
Section 8: Induced Travel ....................................................................................................................................... 27
Results ................................................................................................................................................................... 28
Maintenance Department Module ....................................................................................................................... 29
Section 9: Updating GASCAP ................................................................................................................................... 32
Introduction

GASCAP is a Microsoft Excel based spreadsheet tool designed for the New Jersey Department of Transportation to estimate greenhouse gas emissions associated with transportation capital projects. The current version includes sections to calculate emissions for the following:

Section 1: Materials - Estimates direct and upstream emissions for materials used in construction projects based on item codes from NJ DOT project bid sheets.

Section 2: Non-Road Equipment - Estimates direct and upstream emissions for non-road equipment used during construction activities.

Section 3: Recyclables - Estimates a credit against estimated emissions based on the use of various recycled materials in construction projects.

Section 4: Lifecycle Maintenance - Estimates direct and upstream emissions based on expected materials and equipment that will be used in maintaining the completed product over its lifespan.

Section 5a: Staging - Estimates direct and upstream emissions for on-road vehicles and temporary lighting used during construction of a project.

Section 5b: Traffic Disruption - Estimates direct and upstream emissions resulting from changes in vehicle miles of travel and vehicle efficiency due to work zones, lane closures, and detours.

Section 6: Lighting - Estimates direct emissions from the operation of permanent lighting fixtures over the lifespan of a project.

Section 7: Rail - Estimates direct and upstream emissions for various inputs that are specific to rail construction projects.

Section 8: Induced Travel - Estimates changes in mobile source emissions caused by changes in road capacity

Maintenance Department Module - Estimates emissions from routine, minor maintenance activities.

Section 9: Updating GASCAP - Procedures for updating background data on energy, vehicles, and materials used by GASCAP when estimating emissions.
Enabling Macros

Most of the functionality of GASCAP is contained within macros, which are scripts that automate calculations and other program functionality. By default, macros are usually disabled in Excel. After opening the spreadsheet, a prompt will ask if the user wishes to enable macros or will present a security warning that some content is disabled. This prompt should be followed to enable macros. Macros must be enabled to load and run GASCAP.
The first worksheet displayed after enabling macros is the Project Info page. Basic information about the project (title, location, start and end dates, and description) should be entered here. The Reset button can also be used to reset the entire workbook and remove all items added in all sections. The project title displayed on other sheets is linked to the one entered on this page.

It is **critical to program functionality** that estimated project start and end dates are entered, even if they are very rough estimates. The dates are used to calculate project length (displayed on the Project Info page for reference) which is used in several emission calculation functions.
Section 1: Materials

Material inputs to GASCAP are based on NJ DOT bid sheet item codes. The first step in entering a material is to input the 7-digit item code from the bid sheet. After inputting the item code, clicking 'Go' will display the appropriate unit of measurement for the item and pre-populate default variables for that item.

If you do not know an item’s 7-digit code, you can click “Find Codes” to look up codes by item name. Then click “Ok” to send the code to Input Item Code box and click “Go.”

The second step is to input the quantity of the item, which is located next to the item code on the bid sheet. Additionally, in step 3, default variables related to asphalt and concrete are displayed. These variables can be changed if desired. Variables that do not apply to the item selected will be greyed out. Clicking the Add Material button creates a new line item on the spreadsheet with emissions factors (in grams) for that item, and updates the total emissions for all materials. Individual line items can be removed by their respective buttons, or the entire sheet can be reset with the appropriate button. Total emissions can be viewed in grams or metric tons.
Section 1: Materials
Section 2: Equipment

Section 2 is where all non-road equipment used during construction should be entered. There are two methods for entering equipment as shown below. Click the button for the method you want to use.

**Method 1: Enter Equipment Activity Manually**
Choose Method 1 if you know what pieces of non-road equipment will be used in the project and how long each piece of equipment will be operating. Equipment is selected through a series of drop down boxes that must be selected in order.

**Method 2: Estimate Equipment Activity**
Choose Method 2 if you do not know what pieces of equipment will be used or for what period of time. GASCAP will allow you to estimate the number of hours of equipment activity for 38 pieces of non-road equipment based on a sample of projects.
Method 1 Enter Equipment Activity Manually

Step 1: Select the year the vehicle was manufactured
Step 2: Select the type of equipment
Step 3: Select the type of fuel used
Step 4: Select the vehicle’s power rating
Step 5: Enter the number of hours the vehicle will be used in total during construction
Step 6: The ‘Add Equipment’ button will add a line item on the spreadsheet with emissions factors (in grams) for that item, and updates the total emissions for all equipment.

Before hitting the ‘Add Equipment’ button, the box labeled ‘Air Conditioning?’ should be checked if the equipment has it. Individual line items can be removed by their respective buttons, or the entire sheet can be reset with the appropriate button. Total emissions can be viewed in grams or metric tons.
Method 2: Estimate Equipment Activity

Step 1: Enter the expected number of workdays in the textbox and click “OK.” (Remember workdays do not include holidays or weekends on which no work will be performed).

Step 2: Select one of six project types from the dropdown menu. Choose which of the following best describes the current project:

1. Resurface Existing Highway
2. Construct Freeway / Extra Lane
3. Pavement Rehabilitation / Widening
4. Construct / Reconstruct Bridge
5. Construct Median, Thrie Beam Barrier
6. Landscaping

Then click “Estimate Phasing.”
Step 3: The phasing describes what portion of the project work (in hours) is allocated to each phase—
or general category of activity. To accept the default phasing, simply go to Step 4. To alter the
default phasing, click the “Change Default Phasing” button to bring up the below menu. Enter
new values for the percent of time devoted to each phase. To account for rounding errors, the
total may range from 99.8% to 100.2%.

Click the “Update Phasing Values” button to update the value.

Different mixes of equipment are used in each phase, so accurate phasing helps GASCAP to more
closely approximate the specific project.

“Change Contract Orders” is an allowance for extra construction time due to changes in the contract.
“Other” accounts for time that is spent performing uncategorized activities.
Step 4: Click the “OK” Button on the main screen to populate a default list of equipment activity and emissions.

Step 5: If you need to change the default hours of activity, model year, fuel type, or power of equipment, click the “Change” button next to the piece of equipment you would like to alter, as shown below.

### EQUIPMENT ACTIVITY ESTIMATION

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Fuel Type</th>
<th>Power Rating</th>
<th>Hours of Activity</th>
<th>Air Conditioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Bore Drill Rig</td>
<td>Diesel</td>
<td>175</td>
<td>59.1</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Cement &amp; Mortar Mixers</td>
<td>4 Stroke Gasoline (10% Ethanol RFC)</td>
<td>11</td>
<td>0.0</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Dumper/Fenders</td>
<td>4 Stroke Gasoline (10% Ethanol RFC)</td>
<td>11</td>
<td>11.5</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Concrete/Industrial Saws</td>
<td>4 Stroke Gasoline (10% Ethanol RFC)</td>
<td>11</td>
<td>31.7</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Crane</td>
<td>Diesel</td>
<td>300</td>
<td>4.4</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Crushing/Proc. Equipment</td>
<td>Diesel</td>
<td>75</td>
<td>0.0</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Loader Tractors</td>
<td>Diesel</td>
<td>175</td>
<td>0.0</td>
<td>No</td>
</tr>
<tr>
<td>2008</td>
<td>Excavator</td>
<td>Diesel</td>
<td>175</td>
<td>119.7</td>
<td>No</td>
</tr>
</tbody>
</table>

The “Change” button will bring up a menu for selecting the equipment model year, fuel type and horsepower (which you must change in that order). Check the Air Conditioning box if the specific equipment model uses air conditioning.

To change the Hours of Activity, simply overwrite the previous value. There is no way to remove equipment from the list. If the equipment will not be used at all, specify 0 as the Hours of Activity.

Then click “Update.”

![Update Equipment Activity](image)
Section 3: Recyclables

The Recyclables worksheet displays a list of recycled materials that will give a credit against emissions if used in the project. The amount of each material used in pounds should be entered in the respective cell. Pressing the 'Calculate Recycled Materials Credit' button will update the Recycled Materials Credit totals to reflect the amount of the credit. Pressing Reset returns all values to zero. Total emissions can be viewed in grams or metric tons.
Section 4: Lifecycle Maintenance

The Lifecycle Maintenance section is designed to estimate direct and upstream emissions based on expected materials and equipment that will be used in maintaining the completed product over its lifespan. *Bridge lifecycle maintenance is not estimated in the current version.*

Each field in the steps below is populated with default values that may be changed.

Step 1: Select the Pavement Type from the dropdown (Asphalt, Concrete, or Asphalt Overlay Concrete)
Step 2: Enter the Length of the project in miles.
Step 3: Enter the number of Lanes
Step 4: Enter the Pavement Depth (in inches) of the main roadway
Step 5: Enter the Combined Width (in feet) of both shoulders of the roadway
Step 6: Enter the Pavement Depth for the shoulders of the roadway
Step 6: Enter the distance (feet) for Transverse Joint Spacing *(Step 6 does not apply when the Pavement Type is Asphalt.)*

Click “Update Maintenance.”
## Section 4: Lifecycle Maintenance

<table>
<thead>
<tr>
<th>Total Lifecycle</th>
<th>Asphalt Pavement</th>
<th>Concrete Pavement</th>
<th>Asphalt Overlay Concrete Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 years</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Concrete patch 2 - 10% of pavement area</td>
</tr>
<tr>
<td></td>
<td>Micro surface all lanes and shoulders</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
</tr>
<tr>
<td>10 years</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Concrete patch 2 - 10% of pavement area</td>
</tr>
<tr>
<td></td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Clean and seal 100% of transverse joints</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
</tr>
<tr>
<td></td>
<td>Micro surface all lanes and shoulders</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Bituminous overlay to 4 in. depth</td>
</tr>
<tr>
<td>20 years</td>
<td>Mill wearing course to 2 in. depth</td>
<td>Concrete patch 2 - 10% of pavement area</td>
<td>Concrete patch 2 - 10% of pavement area</td>
</tr>
<tr>
<td></td>
<td>Bituminous inlay to 2 in. depth</td>
<td>Diamond grind 100% of total area</td>
<td>Mill wearing course to 2 in. depth</td>
</tr>
<tr>
<td></td>
<td>micro surface shoulders</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Bituminous inlay to 2 in. depth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean and seal 100% of transverse joints</td>
<td></td>
</tr>
<tr>
<td>30 years</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Concrete patch 2 - 10% of pavement area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Diamond grind 100% of total area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Micro surface all lanes and shoulders</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean and seal 100% of transverse joints</td>
<td></td>
</tr>
<tr>
<td>40 years</td>
<td>Full depth patch 5% of pavement area</td>
<td>Concrete patch 2 - 10% of pavement area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mill wearing course to 4 in. depth</td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bituminous inlay to 4 in. depth</td>
<td>Bituminous overlay to 4 in. depth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>micro surface shoulders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 years</td>
<td>Clean and seal 100% of longitudinal joints</td>
<td>Concrete patch 2 - 10% of pavement area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crack seal 500 ft. per lane mile (PA)</td>
<td>Mill wearing course to 2 in. depth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Micro surface all lanes and shoulders</td>
<td>Bituminous inlay to 2 in. depth</td>
<td></td>
</tr>
</tbody>
</table>
Section 5a: Staging

Transportation

The Staging worksheet allows emissions to be estimated for activities involved in staging the construction site. The first box, Transportation, is similar in function to the Equipment worksheet, except with on-road vehicles.

Step 1: Select the vehicle type
Step 2: Select the year the vehicle was manufactured
Step 3: Select the type of fuel used
Step 4: Enter the one way distance of a trip with that vehicle type
Step 5: Enter the number of one way trips made with that vehicle type
Step 6: Enter the number of vehicles of that type
Step 7: The ‘Add Item’ button will add a line item on the spreadsheet with emissions factors (in grams) for that item, and updates the total emissions for all equipment.

To assist in determining distance traveled, a quick Distance Calculator box accepts the input of a starting and ending 5-digit zip code; clicking the ‘Find Distance’ button will bring up the user’s web browser with a Google Maps page giving the driving miles between the two zip codes.

Construction Site Lighting

The second part of calculating construction staging emissions involves estimating the use of lighting for nighttime work at the site. By default, the power is generator based. In this event, please verify that generators were added as equipment items in Section 2.

If the power is grid-based, choose that option in the drop down box. The sheet then prompts for the number of fixtures, watts per fixture, and operating hours per day. Multiple line items can be added. The operating hours box is prepopulated with an estimated figure based on the actual daylight hours expected based on the dates of the project. This default number can be changed if desired. Pressing the ‘Add Lighting’ button creates a new line item on the spreadsheet with emissions factors (in grams) for that item, and updates the total emissions for all materials. Pressing Reset returns all values to zero. Total emissions can be viewed in grams or metric tons.
Section 5a: Staging
Section 5b: Traffic Disruption

Section 5b estimates the emissions from six project staging options, which result in changes in traffic patterns that occur during roadway construction and maintenance. GASCAP classifies staging procedures as one of the following work zone types:

1. Work Zone Only
   - No lanes closed, with workers present during construction for the duration of the project

2. Lane Closure
   - One or more, but fewer than all, lanes are closed for the duration of the project

3. Intermittent Lane Closure
   - One or more, but fewer than all, lanes are closed during specific periods each day or week, but otherwise open, for the duration of the project

4. Full Road Closure
   - Road is fully closed (all lanes) for the duration of the project, with a signed diversion route

5. Combination Road and Lane Closure
   - Road is fully closed (all lanes) during specified periods each day or week, with a signed diversion route; otherwise one or more, but fewer than all, lanes are closed.

6. Intermittent Road Closure
   - Road is fully closed (all lanes) during specific periods each day or week, with a signed diversion route, but otherwise open, for the duration of the project

7. Intermittent Work Zone
   - No lanes closed, with workers present during construction during specific periods each day or week, for the duration of the project

Traffic flow changes in GASCAP are based on calculations from the 2010 Highway Capacity Manual. Because different emissions impacts must be calculated for each staging procedure, this is the most complex module in GASCAP. Some staging procedures will require entering additional data, as noted in the procedures below.
Step 1: Select the Staging Option from the dropdown menu

Step 2: Click the Enter Details Button to open the Work Zone details window.

Section 5b: Traffic Disruption
Step 3.1: Enter the following Descriptions of the roadway at the site of the Work Zone:

a. Name of the roadway
b. Length (in miles) of the segment of the roadway affected by the work zone
c. The functional class of the roadway at the work zone.
   
   Note: Selecting a functional class will populate default values for Physical Characteristics of the roadway. These may be changed in Step 3.4
d. The number of lanes per direction of that road segment at the work zone
e. The Annual Average Daily Traffic (AADT) for the roadway

Step 3.2: Accept Default Values for the Single Base Lane Capacity of the Work Zone, or enter:

a. The dominant direction of traffic flow at the work zone
b. The total flow at the work zone
c. The opposite direction flow at the work zone is then calculated automatically

Step 3.3: Enter the Intermittency schedule for intermittent lane/road closures:

Note: Step 3.3 applies only for intermittent work zones. During Step 1, if you selected any staging options other than 3 (Intermittent Lane Closure), 5 (Combination Road and Lane Closure), 6 (Intermittent Road Closure) or 7 (Intermittent Work Zone) this section will appear as “grayed out” and the fields will be inactive.

a. The number of days per week the lane/road closure is expected to take place
b. The start time at which the lane/road closure is expected to begin each day
c. The finish time at which the lane/road closure is expected to end each day.

Step 3.4: Enter the following Physical Characteristics of the Roadway around the site of the work zone:

a. The lane width (in US Feet)
b. The posted speed limit (in miles per hour)
c. Select TRUE if there is a median within the work zone; otherwise select FALSE
d. The number of ramps per mile within the work zone plus three miles upstream and downstream of the work zone for Freeways, or the number of access points per mile (driveways and unsignalized intersections within the work zone for other road types)
e. The lateral clearance (shoulder width) on the left and right sides of the roadway at the work zone
f. The directional split of traffic (proportion from 0.00 to 1.00 of traffic flowing in the dominant direction) at the work zone
g. The grade (either Level, Rolling, or Mountainous) of the roadway at the work zone
h. No passing Lane – Level
i. No Passing Lane – Rolling
j. Whether the work zone is in an Urban or a Rural location

**Step 3.5:** Click the Update Values button.

**Step 4:** Accept the default values or enter custom values for the proportion (from 0.000 to 1.000) of vehicles using the roadway that are:

a. Passenger Cars
b. Trucks or Buses
c. Recreational Vehicles (RVs)

*Note: Entered values must add up to 1.000*

Click “Update Values.”

If staging procedure 1 (Work Zone Only) is selected, this is all of the information that is required.

If staging procedure 2 (Lane Closure), 3 (Intermittent Lane Closure) is selected, you will be prompted to enter the number of lanes affected by closures in the following dialogue:

![Lane Closure Dialogue]

**Step 5.1:** Enter the number of lanes to be closed in the dominant direction. The maximum number of lanes that can be closed is one less than the total number of lanes in the work zone. If all of the lanes are to be closed, this would be classified as a Road Closure.

If staging procedure 4 (Full Road Closure) or 6 (Intermittent Road Closure) is selected, you will be prompted to enter further information for establishing a detour.

**Section 5b: Traffic Disruption**
Section 5b: Traffic Disruption

Step 6.1: Enter the number of links (1 – 5) for the signed diversion route resulting from any road closures.

![Image of Number of Diversions dialog box]

Step 6.2: Enter the following details for each diversion route link into the dialogue box shown below:

a. Enter the Description, Single Lane Base Capacity, and Physical Characteristics for each link in the detour, as in Step 3

b. Accept, for each detour link, the default values or enter custom values for the proportion (from 0.000 to 1.000) of vehicles using the roadway that are:
   1) Passenger Cars
   2) Trucks or Buses
   3) Recreational Vehicles (RVs)

   Note: Entered values must add up to 1.000

If staging procedure 5 (Combination Road and Lane Closure) is selected, you will be prompted to enter information about BOTH a road closure with detour and a lane closure. Refer to Steps 5.1 - 6.2.
Section 6: Lighting

The Lighting worksheet estimates direct emissions from traffic lights and street lights that are installed as part of the project over their operating lifespan.

Step 1: Select the lighting type
Step 2: Select the power rating for the light if necessary
Step 3: Enter the number of lamps or signal heads
Step 4: Enter the anticipated number of operating years

Pressing the ‘Add Item’ button creates a new line item on the spreadsheet with emissions factors (in grams) for that item, and updates the total emissions for all materials. Pressing Reset returns all values to zero. Total emissions can be viewed in grams or metric tons.
Section 7: Rail

Section 7 estimates emissions from the construction of railway projects.

Step 1: Select the category of rail item to be added.
Step 2: Select the specific item within that category.

Step 2 will determine the remaining steps, dependent on the variables involved with the selected item. Variables for specific items include:

**Joint Bars**: When selecting joint bars, the user will be prompted for rail length in order to determine how many joint bars are required. Rail length options are 39 feet, 80 feet, or continuous. If continuous is selected, the user will be prompted to enter the continuous rail length.

**Timber Ties**: For timber ties, the user is prompted to choose a timber disposal method. The disposal method will result in a credit against emissions due to either the burning of the timber as fuel or the storing of it in a landfill (carbon sequestration).

For all items that are dependent on length of track, the user will be prompted to enter the number of parallel tracks. As most items require an input in feet, there is a simple calculator on the page that can be used to convert miles into feet. Pressing Reset returns all values to zero. Total emissions can be viewed in grams or metric tons.
Section 7: Rail
Section 8: Induced Travel

Section 8 of GASCAP estimates the additional impact of mobile emissions from induced travel—the increase (or decrease) in travel activity that occurs in response to adding (or removing) capacity from a roadway, assuming that the project life is 50 years.

**Step 1:** Select “Yes” if the project has either added or reduced road capacity; otherwise select “No.”

**Step 2:** Enter the additional capacity in lane-miles for each class of road (Expressways/Freeways/Interstates, Arterial Roads, Collector Roads, Local Roads) that will result from the project. If capacity has been reduced, enter the change as negative lane-miles.
Results

The Results worksheet displays the cumulative results from all sections of GASCAP. In addition to results from each individual section, the worksheet contains emission estimation totals for the entire project, and an estimated fuel consumption box based on the Equipment and Staging sections. Current fuel prices can be entered and the total cost updated by pressing the ‘Update Fuel Costs’ button. The ‘Print Results’ button will print all results in a two page format.
Maintenance Department Module

GASCAP’s Maintenance module addresses planned rehabilitations of NJDOT facilities, but not routine maintenance, such as pothole filling and crack sealing. To address this gap, GASCAP includes a special module for estimating direct and upstream emissions from equipment fuels and materials from routine maintenance activities to enable a more complete life-cycle analysis with respect to capital projects. The results from this data gathering module are treated as separate section from other GASCAP modules.

Maintenance Equipment

Step 1: Click the “Equipment” radio button to begin adding equipment.

Step 2: Enter (in the following order) the type; quantity of pieces; model year; fuel; time spent idling; miles travelled; horse power rating; and air conditioning for each equipment item you would like to add. Not all fields are applicable to every equipment item, and may appear grey.

Step 3: Click “Update Maintenance” to add equipment. The item will appear in list the bottom of the spreadsheet (once for running emission and once for idling emissions). Click the “Remove” button to the right of the item to remove it from the equipment list.

Maintenance Materials

Step 1: Click the “Materials” radio button to begin adding materials.

Step 2: Enter (in the following order) the type; heating temperature; outdoor ambient temperature; quantity; percentage of binder; percentage of aggregate moisture; and solvent type for each material item you would like to add. Not all fields are applicable to every material and may appear grey.

Step 3: Click “Update Maintenance” to add materials. The item will appear in list the bottom of the spreadsheet. Click the “Remove” button to the right of the item to remove it from the materials list.

Viewing and Saving Detailed Results

A summary of the maintenance emissions appears on main worksheet. You can also view emissions separately for materials; generators; idling vehicles; and running vehicles. To see separate results, click “View Detailed Results” to navigate to the results page.

Clicking “Save” on the data entry sheet opens a dialogue to save the results in a new workbook. The first sheet will contain the list of equipment and materials. The second sheet will contain detailed results from the module. Once the results are saved, the module will automatically reset.
### CURRENT MAINTENANCE RESULTS

#### Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Direct</th>
<th>Unit</th>
<th>Upstream</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct CO₂</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂</td>
<td>g</td>
</tr>
<tr>
<td>Direct CH₄</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CH₄</td>
<td>g</td>
</tr>
<tr>
<td>Direct N₂O</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream N₂O</td>
<td>g</td>
</tr>
<tr>
<td>Direct PM₁₀</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream PM₁₀</td>
<td>g</td>
</tr>
<tr>
<td>Direct CO₂ Equiv. from HFCs</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream SF₆</td>
<td>mg</td>
</tr>
<tr>
<td>Direct CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂ Equiv</td>
<td>g</td>
</tr>
<tr>
<td>Combined CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

#### Generators

<table>
<thead>
<tr>
<th>Material</th>
<th>Direct</th>
<th>Unit</th>
<th>Upstream</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct CO₂</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂</td>
<td>g</td>
</tr>
<tr>
<td>Direct CH₄</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CH₄</td>
<td>g</td>
</tr>
<tr>
<td>Direct N₂O</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream N₂O</td>
<td>g</td>
</tr>
<tr>
<td>Direct PM₁₀</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream PM₁₀</td>
<td>g</td>
</tr>
<tr>
<td>Direct CO₂ Equiv. from HFCs</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream SF₆</td>
<td>mg</td>
</tr>
<tr>
<td>Direct CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂ Equiv</td>
<td>g</td>
</tr>
<tr>
<td>Combined CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

#### Vehicle Idling Emissions

<table>
<thead>
<tr>
<th>Material</th>
<th>Direct</th>
<th>Unit</th>
<th>Upstream</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct CO₂</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂</td>
<td>g</td>
</tr>
<tr>
<td>Direct CH₄</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CH₄</td>
<td>g</td>
</tr>
<tr>
<td>Direct N₂O</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream N₂O</td>
<td>g</td>
</tr>
<tr>
<td>Direct PM₁₀</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream PM₁₀</td>
<td>g</td>
</tr>
<tr>
<td>Direct CO₂ Equiv. from HFCs</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream SF₆</td>
<td>mg</td>
</tr>
<tr>
<td>Direct CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂ Equiv</td>
<td>g</td>
</tr>
<tr>
<td>Combined CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

#### Vehicle Running Emissions

<table>
<thead>
<tr>
<th>Material</th>
<th>Direct</th>
<th>Unit</th>
<th>Upstream</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct CO₂</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂</td>
<td>g</td>
</tr>
<tr>
<td>Direct CH₄</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CH₄</td>
<td>g</td>
</tr>
<tr>
<td>Direct N₂O</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream N₂O</td>
<td>g</td>
</tr>
<tr>
<td>Direct PM₁₀</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream PM₁₀</td>
<td>g</td>
</tr>
<tr>
<td>Direct CO₂ Equiv. from HFCs</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream SF₆</td>
<td>mg</td>
</tr>
<tr>
<td>Direct CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂ Equiv</td>
<td>g</td>
</tr>
<tr>
<td>Combined CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

#### Total Emissions

<table>
<thead>
<tr>
<th>Material</th>
<th>Direct</th>
<th>Unit</th>
<th>Upstream</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct CO₂</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂</td>
<td>g</td>
</tr>
<tr>
<td>Direct CH₄</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CH₄</td>
<td>g</td>
</tr>
<tr>
<td>Direct N₂O</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream N₂O</td>
<td>g</td>
</tr>
<tr>
<td>Direct PM₁₀</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream PM₁₀</td>
<td>g</td>
</tr>
<tr>
<td>Direct CO₂ Equiv. from HFCs</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream SF₆</td>
<td>mg</td>
</tr>
<tr>
<td>Direct CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td>Upstream CO₂ Equiv</td>
<td>g</td>
</tr>
<tr>
<td>Combined CO₂ Equiv.</td>
<td>0.00 (g)</td>
<td>g</td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

**Maintenance Department Module**
Section 9: Updating GASCAP

Periodically, it may be necessary to update GASCAP with new data with emissions factors, new vehicles, etc. There are several, password-protected modules which allow administrators to easily update the software.

There are 9 modules for updating data in GASCAP:
- Section 9a: Update Global Warming Potential Values
- Section 9b: Process Fuels
- Section 9c: Electricity Production
- Section 9d: Steel
- Section 9e: Other Materials
- Section 9f: Equipment Year
- Section 9g: Staging
- Section 9h: Induced Travel

Before updating Sections 9b - 9e, it is necessary to extract new emissions factors from the latest version of Argonne National Laboratory’s GREET model. For detailed instructions for obtaining these factors, see the Technical Memorandum *Updating GASCAP with Revised Greet Vehicle and Fuel Cycle Values*.

Other Sections may require extracting data from other models, such as NONROAD or MOVES. This will be noted in the instructions for updating these sections.

**Accessing the Update Modules**
To access GASCAP’s updating modules, type the administrator password into the box on the Project Info tab.

![Password Entry](image)

Click Confirm Password. If the password is correct, the confirmation window to the right will appear.

![Password Confirmation](image)

Click OK. Then click the Section 9: Admin button.
Section 9a: Global Warming Potential Values

Click the “Section 9a: Update GWP Values” button at the top of the screen to navigate to the correct worksheet. To update GWP values, replace the existing values for Methane, Nitrous Oxide, Hexafluoride, and HFC-134a. Then click the “Update GWP” button at the bottom.
Section 9b: Process Fuels Emissions Factors

GASCAP allows you to update upstream emissions and combustion emissions for process fuels. Click the “Section 9b: Process Fuels” button to navigate to the correct updating worksheet, shown below.

To update the upstream emissions, click the “Update Process Fuels Upstream Emissions” button. Enter new values for each greenhouse gas and process fuel in the dialogue box shown below. Click Update Factors.

To update the combustion emissions, click the “Update Process Fuels Combustion Emissions” button. Enter new values for each greenhouse gas and process fuel in the dialogue box shown below. Click Update Factors.
Section 9c: Electricity Production

Emissions Factors

Click the “Section 9c: Electricity Production” button to navigate to the correct worksheet, shown below.

1. Enter admin password (Project Info tab)
   (This only needs to be done once per GASCAP session)

2. Click Update Energy Sources for Electricity, Update Transmission Loss or Update Energy Emissions for Electricity

3. Enter revised values in form

4. Click Update Factors

First click the “Update Energy Sources for Electricity” button to update the mix of fuels used to generate electricity. The dialogue below will appear.

Select your region to load default data, either the United States Average or for Northeast. Enter the new values and click Update Factors.
Click the “Update Transmission Loss” button, opening the dialogue box below. Enter the new value for the percentage of electricity lost in transmission. Click Update Factor.

Click the “Update Energy Emissions for Electricity” button to open the updating dialogue box shown below. Select a region to load the default data for either the United States Average or the Northeast. Enter the new emissions factors in grams per million BTUs. Click Update Factors.
Section 9d: Emissions Factors for Steel

Click the “Section 9d: Steel” button to navigate to the worksheet for updating emissions factors associated with virgin and recycled steel, shown below.

To update factors for virgin steel, click the “Update Virgin Steel Emissions Factors” button. Enter the new values in the dialogue box shown below. Click “Update Values.”

To update factors for recycled steel, click the “Update Recycled Steel Emissions Factors” button. Enter the new values in the dialogue box shown below. Click “Update Values.”
Section 9e: Emissions Factors for Other Materials

Click the Section 9e: Other Materials button to navigate to the worksheet for updating emissions factors associated with plastics or other materials, shown below.

Click the “Update Plastics Emissions Factors” button. Enter the new values for carbon dioxide, methane, and nitrous oxide emissions (in grams per ton) for each plastic product type in the dialogue box shown below. Click “Update Values.”

Click the “Update Other Materials Emissions Factors.” Enter the new values for carbon dioxide, methane, and nitrous oxide emissions (in grams per ton) for each other material product type in the dialogue box shown below. Click “Update Values.”
Section 9f: Equipment Data

GASCAP can be updated with new models of construction equipment. Emissions factors for new equipment must be extracted from EPA’s NONROAD model. VTC has prepared scripts for extracting this data using MySQL. See the Technical Memorandum “Updating Equipment Data in GASCAP” for step by step directions for preparing a spreadsheet with updated equipment data for new model years. Then follow the instructions below.

Click the “Section 9f: Equipment” button to navigate to the worksheet for updating equipment, shown below.

Enter the most recent year for new equipment in the box labeled Input Most Recent Year. Click Update Equipment. This will create and open a new worksheet tab called “20xx Data,” as shown below.

Copy and paste the data from the spreadsheet created using NONROAD into the “20xx Data” worksheet. Save and then re-open GASCAP.

You do not need to do anything else. GASCAP will then be able to estimate emissions from new construction equipment.
Section 9g: Staging Emissions Factors

Before updating Staging emissions factors, it is necessary to extract updated data from the latest version of EPA’s MOVES software. See the Technical Memorandum “Updating Staging Emissions Factors in GASCAP” for detailed instructions for creating a spreadsheet with updated data.

Click the “Section 9g: Staging” button to navigate to the worksheet for updating emissions factors associated with transportation of vehicles and personnel to and from construction sites, shown below.

Click the Update Staging Factors button to create and open a new worksheet tab called “Staging Data Update,” shown below.

Copy and paste the updated data from the spreadsheet created with MOVES into the “Staging Data Update” worksheet. Then click the “Update Staging Data” button.
Section 9h: Induced Travel Emissions Factors

Before updating Induced Travel emissions factors, it is necessary to extract updated data from the latest version of EPA's MOVES software. See the Technical Memorandum “Updating Induced Travel Emissions Factors in GASCAP” for detailed instructions for creating a spreadsheet with updated data.

Click the Section 9h: Induced Travel button to navigate to the worksheet for updating emissions factors for Induced Travel, shown below.

Locate the spreadsheet created with MOVES on your computer. Copy and paste complete file path into the box provided.

Click the “Update Induced Travel Emissions Factors” button.