

# NAPA'S GREENHOUSE GAS CALCULATOR

## **INTRODUCTION:**

NAPA's newest Greenhouse Gas Calculator (GHGC2) calculates greenhouse gas emissions relating to hot mix asphalt manufacture in a gate to gate analysis. The user-friendly interface uses drop down lists of typical fuels that are linked to the Climate Change Registry of CO<sub>2</sub>-equivalent emission factors, the universal measure of greenhouse gases. CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) converts minor greenhouse gases into equivalent quantity of carbon dioxide based on the potency of the minor gas. This tool includes global warming potential of carbon dioxide, methane, and nitrous oxide.

The Calculator provides for input of three separate fuels used by the rotary dryer plus three additional fuels used inside the gate by equipment and vehicles. A final category addresses CO<sub>2</sub>e released during grid power generation with unique factors for each state. Fuel used for onsite power generation should be added to the Plant Vehicle category. Generally, the more fuel burned and the higher the carbon content, the more CO<sub>2</sub>-equivalent gases are emitted.

This GHGC update adds emission offset credits for those fuels and activities that either reduce CO<sub>2</sub>e released from cradle to gate or sequester CO<sub>2</sub>. Credits are calculated for plant based bio-fuels, transportation credits for waste derived fuels, and cradle to gate credits for recycled raw materials - RAP and shingles. Credits are also calculated for warm mix asphalt production based on user defined WMA mix temperature.

The Greenhouse Gas Calculator was developed under the leadership of NAPA's Environmental Committee. Refinements and enhancements will be made as need arises based on user feedback. If you have suggestions for enhancements, or questions regarding underlying algorithms, contact Howard Marks, NAPA Director of Regulatory Affairs.

## **EMISSION FACTORS:**

Emission factors used to calculate CO<sub>2</sub>e are taken from tables provided by The Climate Registry (TCR), an independent organization that sets standards for calculating and reporting carbon emissions in North America. It should be noted that TCR factors are not equivalent to EPA's AP-42 emissions factors for hot mix manufacture. AP-42 emission factors were developed using directly measured emissions from stack test data and are expressed in units of tons produced. TCR uses average carbon content of each fuel to calculate carbon dioxide on a mass balance basis. TCR factors are suitable for complying with the EPA Greenhouse Gas Reporting Rule.

As mentioned above, commercial fuels have known carbon content on which a CO<sub>2</sub>e emission factor is based. Many waste derived fuels however such as recycled oil (RO) are not included in TCR due to variations in carbon content. For lack of a more accurate basis, the Greenhouse Gas Calculator assumes that CO<sub>2</sub>e emissions for recycled oil are equivalent to emissions for No. 2 oil per gallon burned. A fuel credit is generated for recycled oil based on the energy savings from extraction, refining and transportation. The same 285kg CO<sub>2</sub>e/tonne liquid factor used to calculate recycling credits for RAP and RAS is used for recycled oil.

## **EMISSIONS**

### **Dryer**

Three separate dryer fuels used at your facility are selected from drop down lists of common and not so common options. Select the fuels used at your facility and then input the total burned during the period of interest. Unit of measure for each fuel is given with the fuel. Natural gas is listed twice (look carefully) to accommodate input in either million cubic feet or deca therms.

Tons of mix produced from fuel burned is used to calculate per unit of production factors in a reportable summary and calculate increased emission offset credits for WMA, RAP and RAS targets. In the bottom center of your display is a dial gauge for MMBTU per ton mix produced based on inputs in the top section. This gauge is provided as a “data check” to assure your inputs are reasonable. If the total amount of fuel entered is outside normal ranges for the tons of mix produced go back and check the accuracy of your input values.

A horizontal bar chart aligns with each fuel and displays the metric tons of CO<sub>2</sub>e emitted from the quantity of fuel entered. Fly your cursor over a bar for the numeric value that corresponds to the bar’s length. There is an option to switch between presenting CO<sub>2</sub>e values in a table or graphically.

### **Equipment**

There are three separate fields dedicated to engine fuels used in support of asphalt mix manufacturing. The CO<sub>2</sub>e emission factors for Plant Equipment vary slightly from Plant Combustion factors due to variations in methane and nitrous oxide formation. The drop down list of fuels is also specific to vehicle fuels including plug in electric and Bio-Diesel. Select the fuels used for Plant Equipment and enter the quantity burned corresponding to the time period used for tons produced and Plant Combustion.

Some facilities use onsite generators for electric power. That fuel should be reported in the Plant Equipment section. CO<sub>2</sub>e emissions are displayed to the right of the inputs and are in units of metric tonnes.

### **Line Power**

This field estimates CO<sub>2</sub>e emissions from line power used by the manufacturing process. It will be a relatively minor contribution to overall GHG emissions. The Climate Change Registry evaluated the unique mix of fuels and renewable generation by geographic region to calculate CO<sub>2</sub>e factors by state and Regional Power Grid. Select your state of operation and enter the kilowatt hours consumed for the reporting period.

## CREDITS

### Warm Mix Asphalt (WMA)

NCHRP 9-47A determined that energy savings from reduced mix temperatures average 1,000 BTU/ton - degree F. The 1,000 BTU factor is used by the GHGC2 to calculate energy savings resulting from producing warm mix at a user defined average mix temperature assuming 310 F temperature for conventional mix. Credits are calculated from the weighted average CO<sub>2</sub>e/BTU for the mix of fuels burned. Enter total tons of warm mix produced for the reporting period and the percent of total production is displayed to the right of the entry window.

WMA emission off-set credits are displayed in a bar graph to the left of the input area. The Tonne CO<sub>2</sub>e Credit's X axis is scaled to match the Tonnes CO<sub>2</sub>e Emissions chart above it. Unlike RAP and RAS credits, WMA credits do not carry down to the reporting summary described in more detail below since WMA energy savings are accounted for in Plant Combustion. As with all other bars the numeric value is displayed when your cursor is over the bar.

### RAP and RAS Utilization

Recycled raw materials generate significant off-set credits due to avoided emission from the mining, processing and transportation of crushed stone and asphalt binder. Factors for avoided emissions are taken from COLAS Materials Road Forward report; 10 kg CO<sub>2</sub>e/tonne crushed stone and 285 kg CO<sub>2</sub>e/tonne asphalt binder. *Many databases offer CO<sub>2</sub>e factors for asphalt binders that vary significantly from 285 kg due to including embodied carbon. While that practice could be appropriate for Green/Sustainability ratings it is not appropriate in calculating climate change emissions.*

Producing asphalt binder is energy intensive. Consequently credits are sensitive to quantity of binder provided by recycled raw materials. Typical AC content of RAP and RAS stockpiles are pre loaded in GHGC2, but should be changed to reflect actual values for the reporting facility. Input tons of RAP and RAS used for the period and verify the calculated percent of total mix produced matches company records.

### Fuels

Several fuel options for both plant and equipment generate emission off-set credits. The total is displayed in the Fuels bar chart. Credit factors for most fuels are taken from The Climate Registry. Since the GHGC2 is a gate to gate analysis, emissions from the production of plant based fuels are not included.

### Targets

Most companies have goals for increased recycle content. This version of the GHGC adds fields to input corporate targets for WMA, RAP and RAS as a percent of total production. Corresponding emission off-set credits are calculated and displayed in the adjacent yellow bars. Actual credits are green bars. Only actual credits are included in the Reportable summary table.

## **REPORTABLE SUMMARY TABLE**

If you are required to report greenhouse gas emissions the Reportable Table summarizes emissions and credits by category. Values are calculated for the reporting period, percent of total and pounds of CO<sub>2</sub>e per ton mix produced. All values for emissions and credit are in metric tonnes. One metric tonne equals 1.1 US short ton.