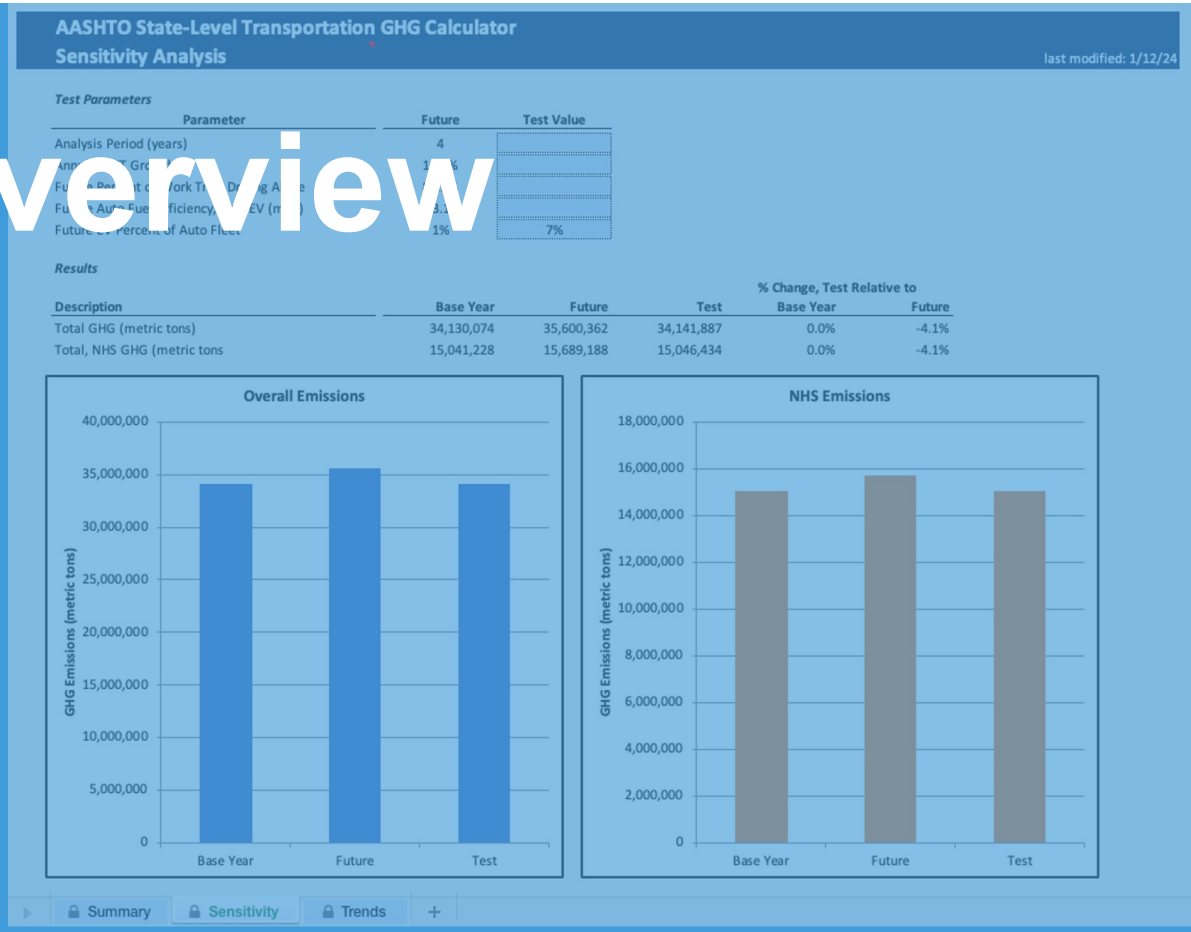
AASHTO Webinar

# GHG Calculator Overview




**Bill Robert, Spy Pond Partners, LLC**

**January 24, 2024**

spy pond partners, llc

# Tool Objectives

- **Illustrate initial calculation of state-level Green House Gas (GHG) emissions (specifically, $CO_2$) on the National Highway System (NHS)**
- **Provide states an approach for testing the sensitivity of the prediction of future GHG emissions to changes in key parameters**
  - Work trips made through Single Occupancy Vehicles (SOV) vs. carpooling, transit, bike/ped or work from home
  - Vehicle Miles Traveled (VMT)
  - Fuel efficiency/Electric Vehicle (EV) adoption

# Disclaimers

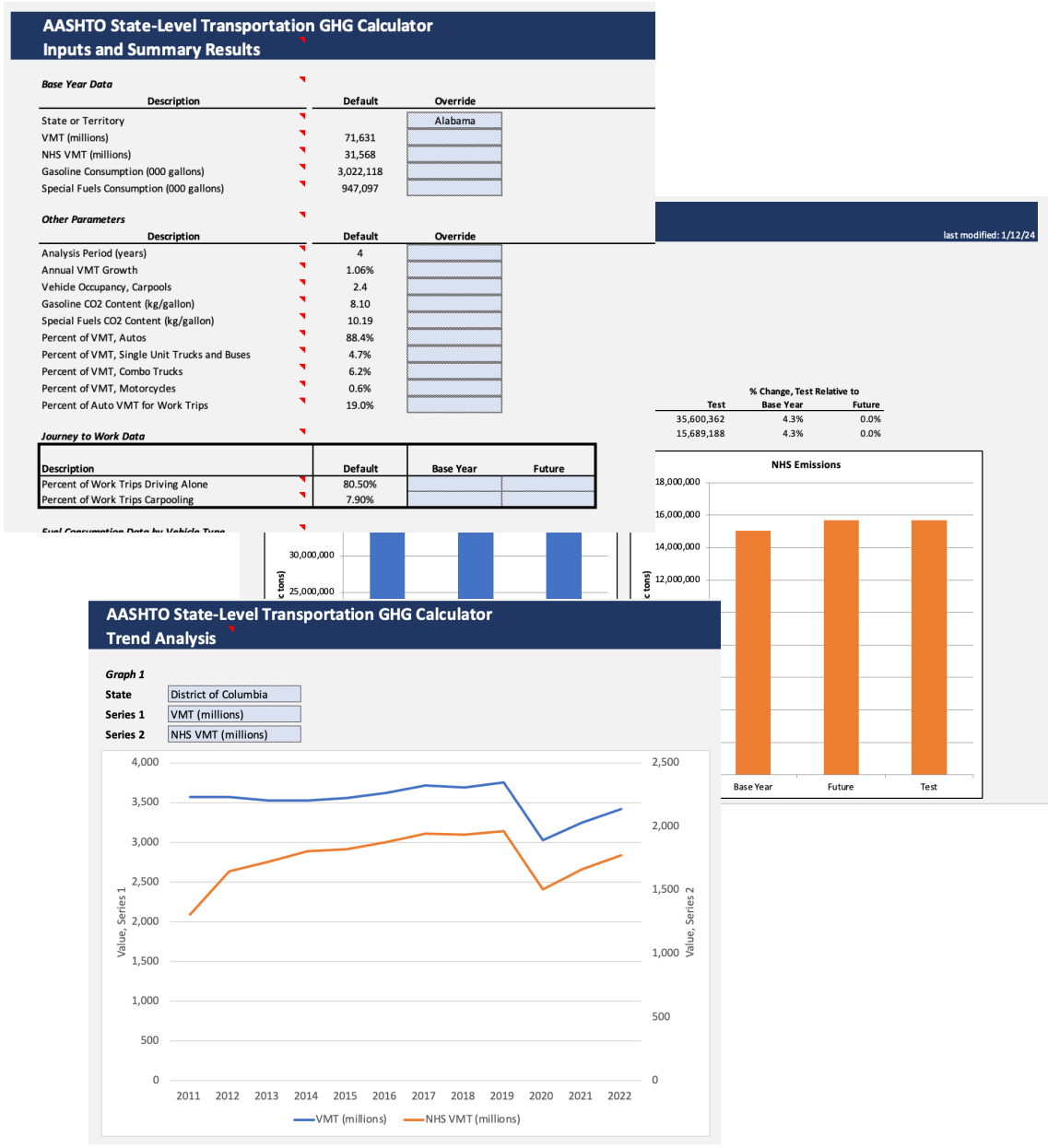
- **The calculation of GHG emissions is based on the FHWA's rule for the NHS GHG measure, but:**
  - We are neither FHWA staff nor working under direction of FHWA.
  - The tool is not a product of FHWA and is not intended to be the authoritative calculation of the GHG measure.
  - The tool is focused on predicting changes in emissions using approaches not addressed in the rule.

# GHG Calculator Implementation

- **Available for download on the AASHTO TPM Portal**
  - https://www.tpm-portal.com/tool/ghg-performance-calculator/
- **Microsoft Excel spreadsheet tool**
- **Organized as a set of three sheets**
- **The sheets of the tool have protection enabled, and in some cases rows used for calculations are hidden**
  - The user can unprotect the sheets and unhide hidden rows as desired to view additional details

# GHG Calculator Components

- **Summary Sheet**
  - Base Year and Future GHG Calculation
- **Sensitivity Sheet**
  - Adjust selected key parameters and view resulting impacts in GHG emissions
- **Trends Sheet**
  - View trends in key parameters by state using published data for 2010-2022

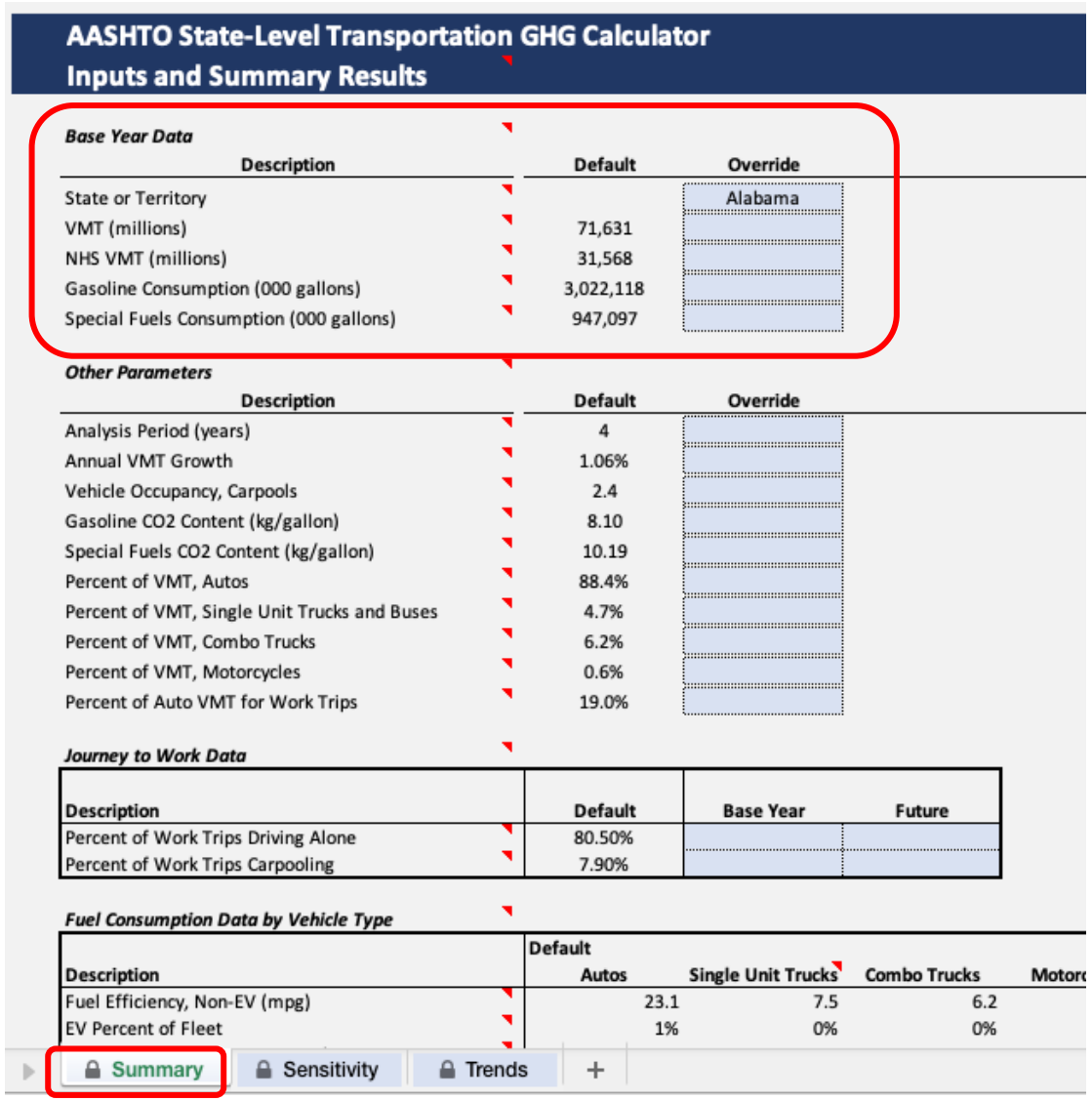


# Calculation Approach

# Inputs: Base Year Data

- State
- VMT
- NHS VMT
- Gasoline Consumption
- Special Fuels Consumption

*Note: base year parameters are populated based on 2022 data for the selected state.*



**AASHTO State-Level Transportation GHG Calculator**
**Inputs and Summary Results**

***Base Year Data***

| Description | Default | Override |
|---|---|---|
| State or Territory | | Alabama |
| VMT (millions) | 71,631 | |
| NHS VMT (millions) | 31,568 | |
| Gasoline Consumption (000 gallons) | 3,022,118 | |
| Special Fuels Consumption (000 gallons) | 947,097 | |

***Other Parameters***

| Description | Default | Override |
|---|---|---|
| Analysis Period (years) | 4 | |
| Annual VMT Growth | 1.06% | |
| Vehicle Occupancy, Carpools | 2.4 | |
| Gasoline CO2 Content (kg/gallon) | 8.10 | |
| Special Fuels CO2 Content (kg/gallon) | 10.19 | |
| Percent of VMT, Autos | 88.4% | |
| Percent of VMT, Single Unit Trucks and Buses | 4.7% | |
| Percent of VMT, Combo Trucks | 6.2% | |
| Percent of VMT, Motorcycles | 0.6% | |
| Percent of Auto VMT for Work Trips | 19.0% | |

***Journey to Work Data***

| Description | Default | Base Year | Future |
|---|---|---|---|
| Percent of Work Trips Driving Alone | 80.50% | | |
| Percent of Work Trips Carpooling | 7.90% | | |

***Fuel Consumption Data by Vehicle Type***

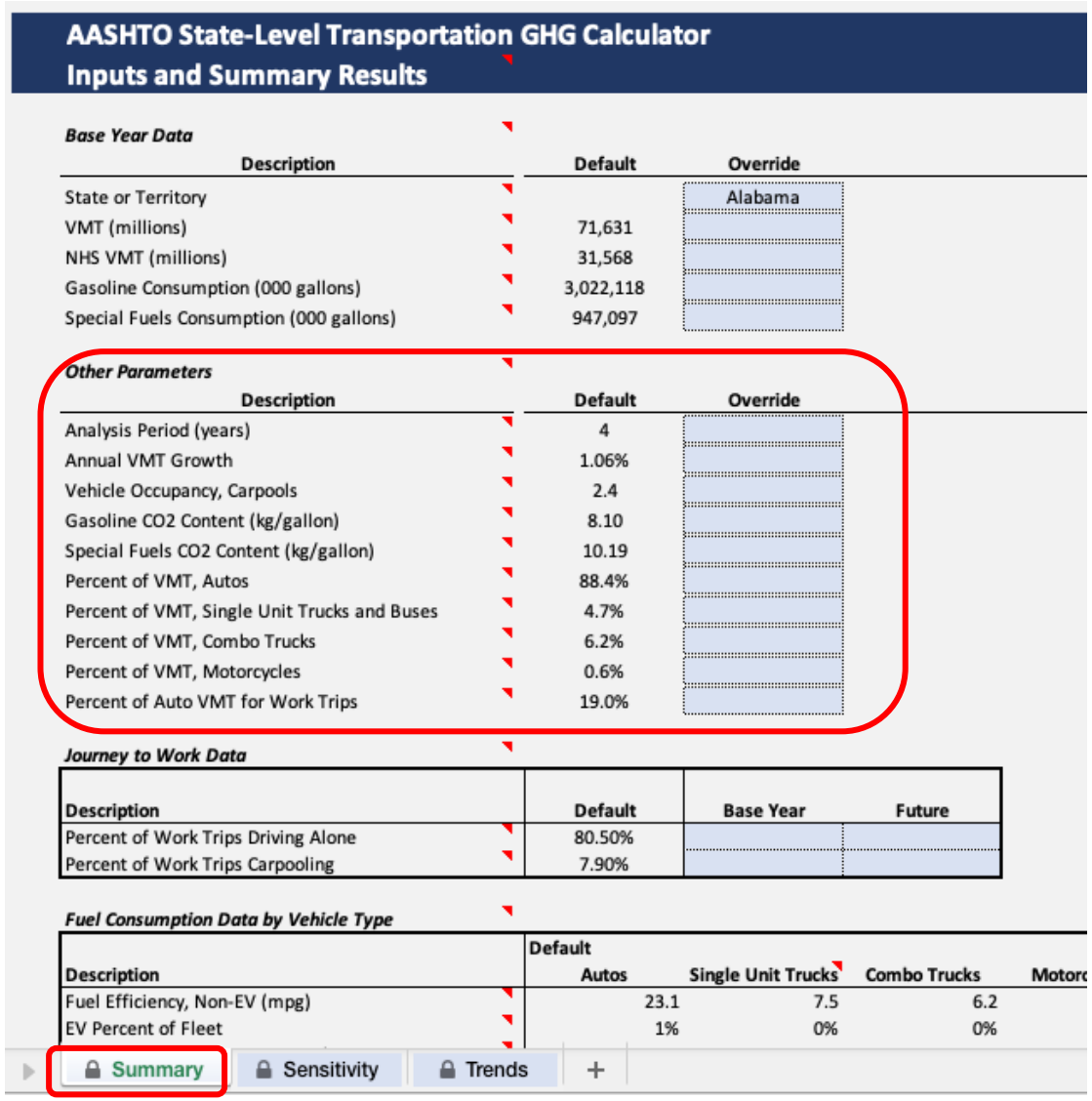
| Description | Default | | | |
|---|---|---|---|---|
| | Autos | Single Unit Trucks | Combo Trucks | Motorc |
| Fuel Efficiency, Non-EV (mpg) | 23.1 | 7.5 | 6.2 | |
| EV Percent of Fleet | 1% | 0% | 0% | |

Summary | Sensitivity | Trends | +

# Inputs: Other Data

- Analysis Period
- VMT Growth
- Vehicle Occupancy for Carpools
- CO2 Content for Gasoline and Special Fuels
- % of VMT by Vehicle Type
- % of Auto VMT for Work Trips

*Note: defaults are populated based on various sources of published data and do not vary by state.*



**AASHTO State-Level Transportation GHG Calculator**
**Inputs and Summary Results**

***Base Year Data***

| Description | Default | Override |
|---|---|---|
| State or Territory | | Alabama |
| VMT (millions) | 71,631 | |
| NHS VMT (millions) | 31,568 | |
| Gasoline Consumption (000 gallons) | 3,022,118 | |
| Special Fuels Consumption (000 gallons) | 947,097 | |

***Other Parameters***

| Description | Default | Override |
|---|---|---|
| Analysis Period (years) | 4 | |
| Annual VMT Growth | 1.06% | |
| Vehicle Occupancy, Carpools | 2.4 | |
| Gasoline CO2 Content (kg/gallon) | 8.10 | |
| Special Fuels CO2 Content (kg/gallon) | 10.19 | |
| Percent of VMT, Autos | 88.4% | |
| Percent of VMT, Single Unit Trucks and Buses | 4.7% | |
| Percent of VMT, Combo Trucks | 6.2% | |
| Percent of VMT, Motorcycles | 0.6% | |
| Percent of Auto VMT for Work Trips | 19.0% | |

***Journey to Work Data***

| Description | Default | Base Year | Future |
|---|---|---|---|
| Percent of Work Trips Driving Alone | 80.50% | | |
| Percent of Work Trips Carpooling | 7.90% | | |

***Fuel Consumption Data by Vehicle Type***

| Description | Default Autos | Single Unit Trucks | Combo Trucks | Motorc |
|---|---|---|---|---|
| Fuel Efficiency, Non-EV (mpg) | 23.1 | 7.5 | 6.2 | |
| EV Percent of Fleet | 1% | 0% | 0% | |

Summary | Sensitivity | Trends | +

# Inputs: Journey to Work Data

- % of Work Trips Driving Alone (SOV): Base Year and Future
- % of Work Trips Carpooling: Base Year and Future

*Note: defaults are populated by state based on data from the American Community Survey (ACS).*

***Journey to Work Data***

| Description | Default | Base Year | Future |
|---|---|---|---|
| Percent of Work Trips Driving Alone | 80.50% | | |
| Percent of Work Trips Carpooling | 7.90% | | |

# Inputs: Fuel Consumption

- **Fuel Efficiency for Non-EVs**
- **EV Percent of Fleet**
- **Percent of Non-EV's Using Gasoline**

*Note: these are all specified by vehicle type for the base year and future periods with national defaults established using various data sources.*

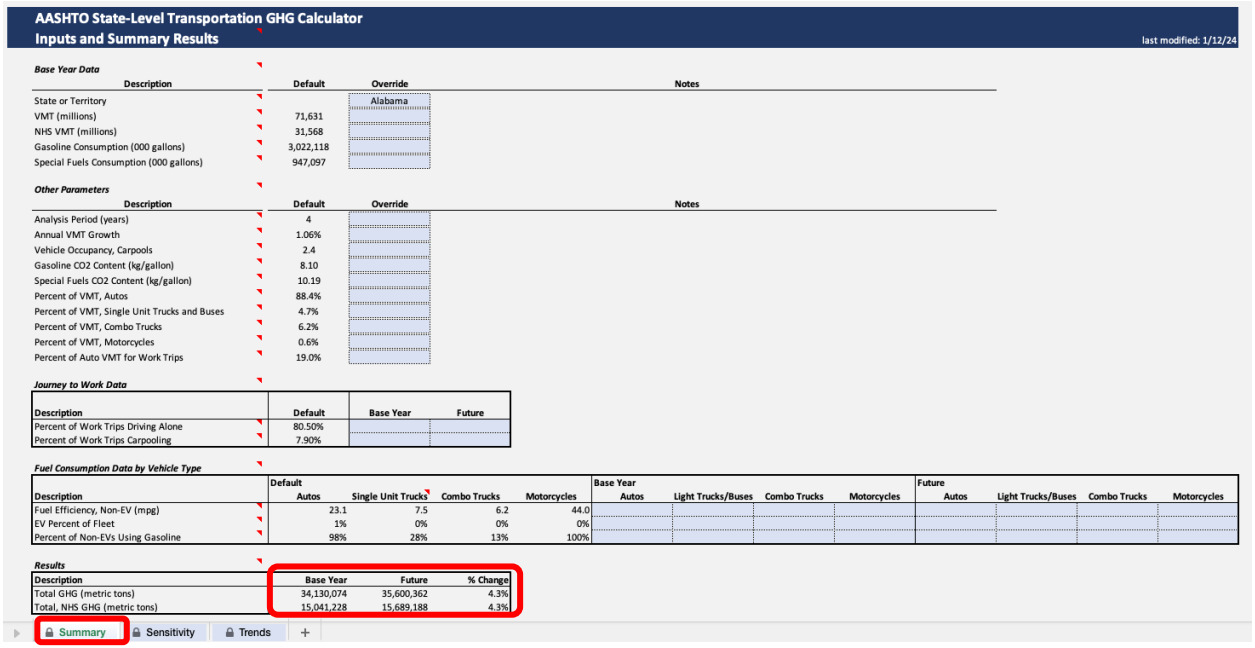
*Fuel Consumption Data by Vehicle Type*

| Description | Default | | | | Base Year | | | | Future | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Autos | Single Unit Trucks | Combo Trucks | Motorcycles | Autos | Light Trucks/Buses | Combo Trucks | Motorcycles | Autos | Light Trucks/Buses | Combo Trucks | Motorcycles |
| Fuel Efficiency, Non-EV (mpg) | 23.1 | 7.5 | 6.2 | 44. | | | | | | | | |
| EV Percent of Fleet | 1% | 0% | 0% | 0% | | | | | | | | |
| Percent of Non-EVs Using Gasoline | 98% | 28% | 13% | 100% | | | | | | | | |

# Outputs

- **GHG: Base Year and Future**
- **NHS GHG: Base Year and Future**
- **Percent Change in GHG**

*Note: Base Year GHG emissions are predicted strictly based on fuel consumption, $CO_2$ content of fuel and % of VMT on the NHS. All other parameters are used to scale the base year predictions to obtain future values.*



**AASHTO State-Level Transportation GHG Calculator**
**Inputs and Summary Results**
last modified: 1/12/24

*Base Year Data*

| Description | Default | Override | Notes |
|---|---|---|---|
| State or Territory | | Alabama | |
| VMT (millions) | 71,631 | | |
| NHS VMT (millions) | 31,568 | | |
| Gasoline Consumption (000 gallons) | 3,022,118 | | |
| Special Fuels Consumption (000 gallons) | 947,097 | | |

*Other Parameters*

| Description | Default | Override | Notes |
|---|---|---|---|
| Analysis Period (years) | 4 | | |
| Annual VMT Growth | 1.06% | | |
| Vehicle Occupancy, Carpools | 2.4 | | |
| Gasoline CO2 Content (kg/gallon) | 8.10 | | |
| Special Fuels CO2 Content (kg/gallon) | 10.19 | | |
| Percent of VMT, Autos | 88.4% | | |
| Percent of VMT, Single Unit Trucks and Buses | 4.7% | | |
| Percent of VMT, Combo Trucks | 6.2% | | |
| Percent of VMT, Motorcycles | 0.6% | | |
| Percent of Auto VMT for Work Trips | 19.0% | | |

*Journey to Work Data*

| Description | Default | Base Year | Future |
|---|---|---|---|
| Percent of Work Trips Driving Alone | 80.50% | | |
| Percent of Work Trips Carpooling | 7.90% | | |

*Fuel Consumption Data by Vehicle Type*

| | Default | | | | Base Year | | | | Future | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Autos | Single Unit Trucks | Combo Trucks | Motorcycles | Autos | Light Trucks/Buses | Combo Trucks | Motorcycles | Autos | Light Trucks/Buses | Combo Trucks | Motorcycles |
| Fuel Efficiency, Non-EV (mpg) | 23.1 | 7.5 | 6.2 | 44.0 | | | | | | | | |
| EV Percent of Fleet | 1% | 0% | 0% | 0% | | | | | | | | |
| Percent of Non-EVs Using Gasoline | 98% | 28% | 13% | 100% | | | | | | | | |

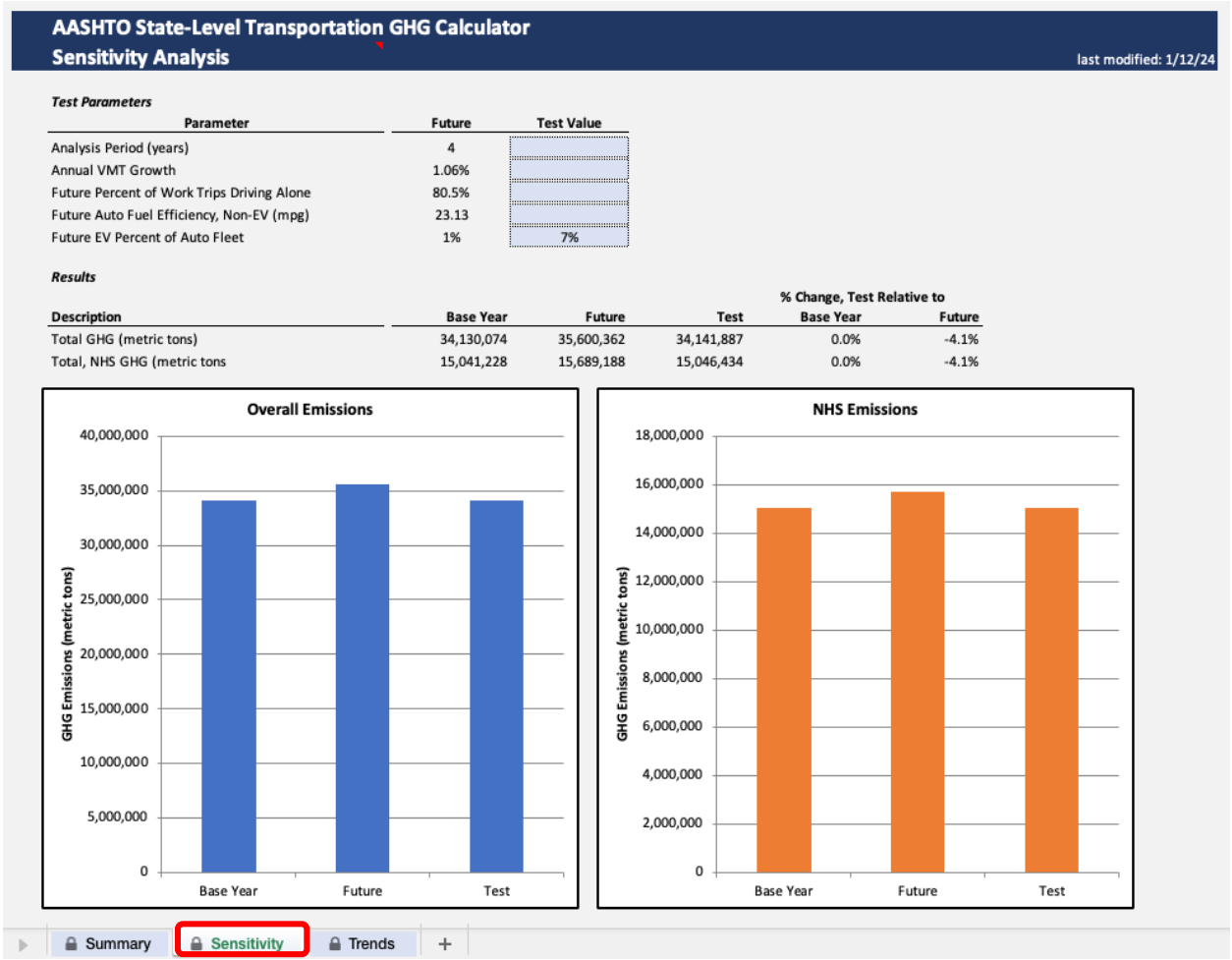
*Results*

| Description | Base Year | Future | % Change |
|---|---|---|---|
| Total GHG (metric tons) | 34,130,074 | 35,600,362 | 4.3% |
| Total, NHS GHG (metric tons) | 15,041,228 | 15,689,188 | 4.3% |

Summary | Sensitivity | Trends | +

# Sensitivity Analysis

- **Use to perform a test calculation based on changes to selected key parameters from the Summary Sheet**
- **Parameters**
  - Analysis Period
  - VMT Growth
  - Fuel Efficiency for Non-EV Autos
  - % of Auto Fleet EV
- **Shows base year, future and test results**



**AASHTO State-Level Transportation GHG Calculator**
**Sensitivity Analysis**
last modified: 1/12/24

*Test Parameters*

| Parameter | Future | Test Value |
|---|---|---|
| Analysis Period (years) | 4 | |
| Annual VMT Growth | 1.06% | |
| Future Percent of Work Trips Driving Alone | 80.5% | |
| Future Auto Fuel Efficiency, Non-EV (mpg) | 23.13 | |
| Future EV Percent of Auto Fleet | 1% | 7% |

*Results*

| Description | Base Year | Future | Test | % Change, Test Relative to Base Year | % Change, Test Relative to Future |
|---|---|---|---|---|---|
| Total GHG (metric tons) | 34,130,074 | 35,600,362 | 34,141,887 | 0.0% | -4.1% |
| Total, NHS GHG (metric tons | 15,041,228 | 15,689,188 | 15,046,434 | 0.0% | -4.1% |

# Trending

- **Trends for 2010-2022**
- **Side-by-side graphs**
- **For each graph select a state and two series to graph**
  - VMT
  - NHS VMT
  - Gasoline Consumption
  - Special Fuels Consumption
  - GHG
  - NHS GHG

# Tool Demonstration

# Questions the Tool Can Help Answer

- **Reality check: What are the overall trends over time in selected data series?**
- **Initial calculation: approximately what do we predict for GHG and the percent change in GHG based on the rule?**
  - Note the disclaimers at the beginning of this presentation!
- **Sensitivity analysis: What impact might selected changes in parameters have on future GHG emissions?**

# Additional Notes

- **Basic approach is to scale the base year GHG calculation for changes in traffic and fuel efficiency**
  - Only way to change the base year calculation is to change base year fuel consumption or $CO_2$ content of fuel
- **Results are extremely sensitive to annual VMT growth and EV adoption rate, in particular**
  - Highly recommend assessing these outside the tool for any formal analyses
- **Can address fuel efficiency changes strictly by adjusting fuel efficiency, by adjusting the EV %, or through a combination**
  - Be careful not to double count impact of EVs

# Qualifications on the Results

- **The tool predicts NHS GHG strictly by multiplying total GHG by the % of VMT on the NHS**
- **The tool does not address a wide variety of additional factors that may impact actual GHG emissions, such as**
  - GHG emissions from electricity generation
  - Impacts of increased traffic congestion
  - Changes in mode for non-work trips
  - …
- **There are likely complex interactions between the different model parameters that are not captured**
- **The tool is not intended as substitute for a comprehensive analysis of GHG emissions**

# Thank You!

spy pond partners, llc