DAF GREENHOUSE GAS (GHG) & CLIMATE CHANGE ASSESSMENT GUIDE for Air Quality

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GREENHOUSE GAS (GHG) & CLIMATE CHANGE ASSESSMENT

GHGs occur in the atmosphere both naturally and because of human activities, such as the burning of fossil fuels and land use change. GHGs produced by fossil-fuel combustion are primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These three GHGs account for more than 97 percent of U.S. total GHG emissions. GHGs are generally non-hazardous to health at normal ambient concentrations; however, GHGs absorb infrared radiation in the atmosphere, and an increase in emissions of these gases is the primary cause of warming of the climatic system and resulting in climate change.

Climate change is the variation in the Earth's climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time. Climate change is primarily driven by accumulation of GHGs in the atmosphere due to the increased consumption of fossil fuels (e.g., coal, petroleum, and natural gas) since the early beginnings of the industrial age and accelerating into the mid- to late-20th century.(IPCC 2021)

From an air quality perspective, context of an action is the local area's ambient (immediate surroundings) air quality relative to meeting the National Ambient Air Quality Standards (NAAQSs). Criteria pollutants are those that create poor air quality, which can damage human health as well as the environment. These include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. Breathing in these pollutants has been linked to a significant increase in lung and respiratory issues, heart disease, childhood development issues, cognitive impairment, and premature death. Impacts on the environment from criteria pollutants include dangerous levels of smog, acid rain, and water pollution. GHGs, on the other hand, are generally non-hazardous to health at normal ambient concentrations and can only potentially cause warming and change to the climatic system at a cumulative global scale. Therefore, generally, action-related GHGs have no significant impact on local air quality.

1.1 Regulatory Background

The Council on Environmental Quality (CEQ) is an entity within the executive office of the President that is responsible for coordinating federal efforts to improve, preserve, and protect America's public health and environment. The CEQ oversees the implementation of NEPA by issuing guidance, interpreting regulations, and approving federal agency National Environmental Policy Act (NEPA) procedures. NEPA requires federal agencies to analyze and consider the environmental effects of their proposed major actions prior to making decisions.

Since the beginning of NEPA in 1970, presidential administrations and courts have struggled with how to implement the mandate for agencies to consider environmental impacts before moving forward with major federal actions that significantly affect the quality of the human environment. In 2016, during the Obama-Biden administration, CEQ directed agencies to consider the impact agency projects had on GHG emissions and climate change. When President Trump assumed office, he ordered that the division roll back the 2016 provisions while further streamlining NEPA reviews to facilitate permitting for infrastructure projects. When President Biden took office, he reversed course and halted all Trump era regulations, signaling a move towards extensive consideration of GHG emissions and climate change in NEPA reporting. In

April of 2022, under direction from President Biden, CEQ published *National Environmental Policy Act Implementing Regulations Revisions* (CEQ 2022), which is the basis for the present guidance. Finally, on January 9, 2023, CEQ published an interim guidance, *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change* (2023 GHG Guidance), so that agencies may make use of it immediately while CEQ seeks public comment on the guidance." (CEQ 2023)

While the details on assessing GHGs and climate change under NEPA is currently (August 2024) in flux, the requirement for assessing a proposed action's potential impact to air quality (include GHGs, as a regulated pollutants) is still mandated under the 2023 GHG Guidance. Additionally, 2023 GHG Guidance suggest providing additional context for GHG emissions through the use of Social Cost of GHG (SC GHG) estimates. Additionally, 2023 GHG Guidance also suggests incorporating Environmental Justice (EJ) considerations into their analyses of climate-related effects. (CEQ 2023)

1.2 Key NEPA/CEQ principles

In developing NEPA and the CEQ Regulations, CEQ developed and followed inherent principles which provides for clarification, structure, and provides integral and elementary guidance. These inherent NEPA/CEQ principles allow agencies to apply their expertise and experience in determining how to consider an environmental effect and prepare an analysis based on the available information.

1.2.1 Inherent NEPA/CEQ principles

Assessing GHG emissions, the SC GHG, and EJ concerns are complex endeavors that cannot be simply performed by estimating the quantity of GHG and then applying SC GHG discount factors. The process requires a comprehensive review of the available methodologies and data in the context of important inherent NEPA/CEQ principles.

> **Rule of Reason and Concept of Proportionality:** Inherent in NEPA and the CEQ Regulations is a "rule of reason" that allows agencies to determine, based on their expertise and experience, how to consider an environmental effect and prepare an analysis based on the available information. (CEQ 2023; section II) Agencies should be guided by the rule of reason, as well as their expertise and experience, in conducting analysis commensurate with the quantity of projected GHG emissions. (CEQ 2023; section IV, A) The rule of reason and the concept of proportionality both caution against providing an in-depth analysis of emissions regardless of the insignificance of the quantity of GHG emissions that the proposed action would cause. (CEQ 2023; section IV, A)
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> **Methodology and Scientific Accuracy:** Agencies shall make use of reliable <u>existing data</u> and resources. Agencies may make use of any reliable data sources, such as remotely gathered information or statistical models. (40 CFR 1506.6(b)) Agencies are not required to undertake new scientific and technical research unless it is essential to a reasoned choice among alternatives, and the overall costs and timeframe of obtaining it are not unreasonable. (40 CFR 1501.3(c))

Significance: Under NEPA, establishing (determining) significance (or insignificance) requires consideration of context of the potentially affected environment and intensity (degree) of the effects. (40 CFR 1501.3(d)) In considering the potentially affected environment, agencies should consider, as appropriate to the specific action, the affected area (national, regional, or local) and its resources and in the case of a site-specific action, significance would usually depend only upon the effects in the local area.

Reasonably foreseeable: Reasonably foreseeable means sufficiently likely to occur such that a person of ordinary prudence would take it into account in reaching a decision. (40 CFR 1508.1(ii))

Effects or Impacts: Effects or impacts means changes (net) to the human environment from the proposed action or alternatives that are reasonably foreseeable and include direct, indirect, cumulative, and both beneficial and detrimental effects. (40 CFR 1508.1(i)) Cumulative effects are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions. (40 CFR 1508.1(i)(3)).

Context and Intensity: The determination of significance is based on "context" and "intensity". Agencies should evaluate the context of an action by considering the characteristics of the geographic area and the potential global, national, regional, and local settings as well as the duration, including short-and long-term effects. Agencies shall analyze the intensity of effects considering the following factors: the degree to which the action may adversely affect public health and safety; the degree to which the action may adversely affect unique characteristics of the geographic area; the action may violate relevant Federal, State, Tribal, or local laws or other requirements; the potential effects on the human environment are highly uncertain; the potential adverse effects on places eligible or on the National Register of Historic Places; adverse effects on endangered or threatened species or their habitats; adverse effects on communities with environmental justice concerns; and adverse effects on rights of Tribal Nations. (40 CFR 1501.3(d))

Relevant Data: Reasonably foreseeable data pertaining to direct, indirect, and/or cumulative effects or impacts associated with an action (or its alternatives) that is essential to a reasoned choice among alternatives. Relevant data only includes data that a person of ordinary prudence would take into account in reaching a decision. (40 CFR 1508.1(ii)) Additionally, agencies do not need to include incomplete but available information that is not essential to a reasoned choice among alternatives and the overall costs of obtaining it are unreasonable. (40 CFR1501.3(c))

Narrowing Scope of Study: NEPA dictates the scoping process is to not only to identify significant environmental issues deserving of study, but also to deemphasize unimportant (insignificant) issues to narrowing the scope of the environmental impact statement process. (40 CFR 1500.4(f))

Net change: NEPA impact assessments are net change analyses used to determine effects/impacts, where relevant reasonably foreseeable data is used for reasoned choice among alternatives. Relevant reasonably foreseeable data is data/information that a person of ordinary prudence would take into account in reaching a decision and is essential to a reasoned choice among alternatives. (40 CFR 1501.3(c) and 1508.1(ii))

1.2.2 NEPA/CEQ Principles Applied to GHG and Climate Change

GHGs are non-hazardous to health at normal ambient concentrations and can only potentially cause warming of the climatic system at a cumulative global scale. Therefore, the action-related GHGs have no significant impact on local air quality. However, from a global perspective, individual actions with GHG emissions each make a relatively small addition to global atmospheric GHG concentrations that collectively may have a large effect on climate change. Therefore, with the global scale of GHG and climate change assessments, these inherent NEPA/CEQ principles become extremely significant considering GHG and climate change effects/impacts are a global issue. The following GHG and climate change assessment guidelines are derived from these NEPA/CEQ principles:

Concept of Proportionality: The concept of proportionality dictates that the level of assessment effort is proportional to the quantity of emissions, the lower the quantity of GHG emission the less important and smaller the GHG/climate assessment effort. If activities have de minimis (insignificant) GHG emissions, then on a global scale they are effectively zero and irrelevant.

Context and Intensity: A key determination for the appropriate level of review/analysis is whether the proposed project may have significant effects on the environment based on "context" and "intensity." The "context" is the consideration of the affected area (global, national, regional, or local) and "intensity" is the degree of the proposed action's effects. Given GHGs are non-hazardous to health at normal ambient concentrations and can only potentially cause warming of the climatic system at a cumulative global scale, the context of a GHG/climate change assessment is only global. The intensity or degree of the proposed action's GHG/climate change effects are indirectly gauged through the quantity of GHG associated with the action.

Reasonably Foreseeable Relevant Data: Reasonably foreseeable data pertaining to direct, indirect, and/or cumulative effects or impacts associated with an action (or its alternatives) that is essential to a reasoned choice among alternatives and only includes data that a person of ordinary prudence would take into account in reaching a decision. Additionally, agencies do not need to include incomplete but available information that is not essential to a reasoned choice among alternatives and the overall costs of obtaining it are unreasonable. The goal is not to be all inclusive, instead the extent of a GHG/climate change assessment is only to the point where a reasoned choice among alternatives can be made. NEPA dictates deemphasizing insignificant issues to narrow the scope of the environmental impact statement process. Therefore, do not include GHG emission sources with an insignificant quantity of GHG emissions and only include sources that the quantity of GHG emissions is high enough that they would be essential to a reasoned choice among alternatives.

Rule of Reason: The rule of reason allows agencies to determine, based on their expertise and experience, how to consider an environmental effect and prepare an analysis based on the available information. Agencies should be guided by the rule of reason, as well as their expertise and experience, in conducting analysis commensurate with the quantity of projected GHG emissions. Therefore, the U.S. Department of Air Force (DAF), based on their expertise and experience, establishes its own guidance on conducting GHG/climate change assessment which is commensurate (proportional) with the quantity of projected GHG emissions.

1.3 GHG Emissions Evaluation

A GHG Emissions Evaluation establishes the quantity of annual net change in speciated GHGs and CO_2 equivalents (CO_2e), determines if an action's emissions are insignificant, and provides a relative significance comparison. The GHG Emissions Evaluation is automated in the Air Conformity Applicability Model (ACAM) version 5.0.21a or newer. In conducting a GHG Emissions Evaluation be sure to apply the NEPA/CEQ principles:

- GHGs potentially cause warming of the climatic system at a cumulative global scale; therefore, the context of GHG emissions and climate change assessment is only global.
- The intensity or degree of the proposed action's GHG/climate change effects are indirectly gauged through the quantity of GHG associated with the action.
- Do not include GHG emission sources with a trivial quantity of GHG emissions that would not have an impact on a global scale.
- Only include sources where the quantity of GHG emissions are high enough that they would be essential to a reasoned choice among alternatives.
- Conduct the GHG Emissions Evaluation commensurate (proportional) with the anticipated quantity of projected GHG emissions.

Based on the current guidance, a GHG Emissions Evaluation must include the following three interrelated elements:

- **GHG Emissions Quantification:** Based on the emission sources or activities entered into ACAM, the annual net change in speciated GHGs and CO_2e emissions associated with an action (or alternative) are automatically quantified.
- **Insignificance Assessment:** The DAF established an "insignificance indicator" below which the action's annual net change in GHG emissions are too low to warrant further consideration. ACAM automatically performs an Insignificance Assessment based on the annual net change in CO_2e emissions for an action (or alternative) which are compared relative to the "insignificance indicator".

- **Relative Significance Assessment:** To allow for a reasoned choice amongst alternatives, a relative comparison analysis is conducted by weighing each alternative's annual net change in GHG emissions value proportionally against the state's (where action will occur) and U.S. annual emission value.

1.3.1 GHG Emissions Quantification

1.3.1.1 Global Net Change Context

GHGs emission estimates are treated like any other air pollutant under NEPA and DAF's Environmental Impact Analysis Process (EIAP) except the context is global impact for GHGs (e.g., climate change) while the context is local impact for criteria pollutants. Given the context is global for GHGs, the Region of Influence (ROI) is also global. Therefore, when evaluating net change in emission the potential emission source must be evaluated as a net change in global GHG emissions. Therefore, from a global context and ROI, there is no net change in GHG emissions for emission source activities that are transferred or relocated from one DAF location to another anywhere globally.

Examples of no net change in GHGs scenarios include (but not limited to) transient aircraft operations, aircraft beddowns where aircraft are relocated but remain sustainably same in operations, automative activities associated with personal reassignments.

1.3.1.2 Net Change in GHG Emissions Quantification

Emissions of GHGs are typically quantified as CO_2, CH_4, N_2O, and in units of CO_2e. The CO_2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. The GWP allows comparison of global warming impacts between different gases; the higher the GWP, the more that gas contributes to climate change in comparison to CO_2. Thus, CO_2 has a GWP of 1, CH_4 has a GWP of 25, and N_2O has a GWP of 298. (40 CFR 98)

Note that starting in 2025, the GWP will change slightly. After 2024 the GWP for CO_2 will remain 1, the GWP for CH_4 will be 28, and the GWP for N_2O will be 265. ACAM version 5.0.25a or later versions will be updated to include the new GWPs for seamless transitions.

While there are many other GHGs, for the purpose of NEPA GHG and climate change assessments, the only speciated GHGs accounted for are CO_2, CH_4, and N_2O. These three speciated GHGs account for greater than 97% of U.S. total GHG emissions; therefore, using only these three GHGs allows for making a reasoned choice among alternatives. As a result, for the purpose of GHG and climate change assessments, CO_2e is calculated as follows; where CO_2e, CO_2, CH_4, and N_2O are in units of weight (e.g., lb, ton, metric ton):

Until January 1, 2025

$$\mathbf{CO_2e = CO_2 + (CH_4 \times 25) + (N_2O \times 298)}$$

Starting January 1, 2025

$$\mathbf{CO_2e = CO_2 + (CH_4 \times 28) + (N_2O \times 265)}$$

For standardization and ease in technical review/verification, all GHG Emission Quantifications must be performed using ACAM. Based on the emission sources or activities entered into ACAM, the annual net change in speciated GHGs and CO_2e emissions associated with an action (or alternative) are automatically quantified. Results of the annual GHG emissions are tabulated in the *ACAM GHG & Climate Change Report*.

Example ACAM, GHG Emissions Quantification Table

Action-Related Annual GHG Emissions (mton/yr)						
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**	**Threshold**	**Exceedance**
2023	16,351	0.81966405	0.10313171	18,808	68,039	No
2024 [SS Year]	17,837	0.89417897	0.11250732	20,518	68,039	No
2025	17,837	0.89417897	0.11250732	20,518	68,039	No
2026	17,837	0.89417897	0.11250732	20,518	68,039	No

Note: [SS Year] is the year in which action related annual GHG emissions reach steady state.

Every Environmental Assessment (EA) or Environmental Impact Statement (EIS) should have a transposed copy for the GHG Emissions Quantification Table from the *ACAM GHG & Climate Change Report* in the GHG and Climate Change section.

1.3.1.3 Special Case - Flight Operations

For air quality impact assessments for criteria pollutants, a ROI for an action is generally a three-dimensional vertical column of air within the mixing zone (i.e., up to the mixing height) where pollutant emissions associated with a proposed action will occur. Unlike criteria pollutants where the ROI is the immediate local area and constrained below the mixing height, when accomplishing GHG estimates the ROI is global because the impact of GHGs is at global scale.

Both the current EPA method for estimating aircraft flight operations emissions (EPA 420-R-92-009) and the General Conformity Rule (40 CFR 93 Subpart B) call for only including criteria pollutant emissions below the mixing height. Given that the mixing height is only associated with microscale air quality criteria pollutant modeling, use of the mixing height for global-scale GHG emissions modeling is considered inadequate. Therefore, logically, if flight-specific fuel consumption data can be predicted on a reasonably foreseeably level, aircraft flight operations GHG emissions used for the “relative comparison analysis” should be calculated using the flight-specific fuel consumption data.

As a result, the DAF methodology for estimating criteria pollutants, emissions below the mixing height, should NOT be used as a standardized methodology for performing a relative comparison analysis for GHGs. GHG emissions should be estimated for the full extent of aircraft movements as part of the projected net change in GHG emissions and with no altitude restriction (not constrained by the mixing height). Therefore, flight-specific fuel consumption data that will be derived from site-specific representative GHG Time-In-Modes (TIMs, for fixed wing aircraft) or GHG Time-In-Phase (TIPs, for rotary wing aircraft) must be used for all impact assessments or emission inventories (default TIMs or TIPs may be used for planning purposes only).

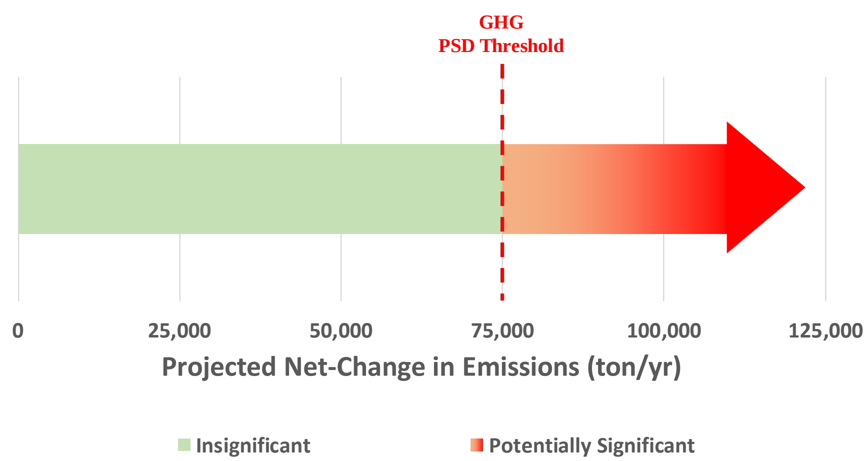
Note: Due to the complexity and highly technical nature of the methodology of deriving aircraft TIMs/TIPs and the need for standardization across the DAF, only AFCEC/CZTQ may derive site-specific representative GHG TIMs or TIPs.

1.3.2 Insignificance Assessment

The DAF adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (tpy) of CO_2e (or 68,039 metric ton per year, mtpy) as an indicator or threshold of insignificance for NEPA air quality impacts in all areas. This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO_2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis beyond producing the *ACAM GHG & Climate Change Reports*. Note that actions (or alternatives) with a net change in GHG (CO_2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment (usually qualitative) to determine if the action poses a significant impact.

For further detail on insignificance indicators see *Level II, Air Quality Quantitative Assessment, Insignificance Indicators* (April 2023). The following figure provides a graphical depiction of the DAF's adopted 75,000 tpy (68,039 mtpy) insignificance indicator for NEPA air quality impacts in all areas regardless of their attainment status.

GHG Insignificance Indicator (Threshold)



Proposed actions with worst-case year annual net change in emissions (i.e., highest annual GHG emissions) below the CO_2e insignificance indicator (75,000 tpy or 68,039 mtpy) are so inconsequential on a global scale that the effects of climate change are also considered inconsequential on a global scale (including the theoretical SC GHG).

Any action with a net change in emissions below 75,000 tpy of CO_2e (insignificance indicator) is insignificant and inconsequential; therefore, no further analysis of GHGs or climate change is required.

All GHG Insignificance Assessments are automatically performed in ACAM. Based on the emission sources or activities entered into ACAM, the annual net change in CO_2e emissions associated with an action (or alternative) are flagged as "Yes" or "No" for exceeding the GHG insignificance threshold. Results of the annual GHG Insignificance Assessments are tabulated in the left two columns of the ACAM GHG Emissions Quantification Table in the *ACAM GHG & Climate Change Report* (see the above *Example ACAM, GHG Emissions Quantification Table*).

If the Insignificance Assessment indicates **all years are insignificant (Exceedance = No)**:

- For CATEX Actions:
  - Document the specific and General Conformity exemption (if applicable) on the AF Form 813.
  - If ACAM analysis was performed (not required), attach a copy of the *ACAM GHG & Climate Change Report* for all action alternatives.
- For EA or EIS Actions:
  - For each alternative, the GHG in Climate Change section of an EA or EIS should ONLY include:
    - Copies for the *GHG Emissions Quantification Table* from the *ACAM GHG & Climate Change Report*. A summary table, comparing each alternative's quantified GHG emissions and the GHG insignificance indictor value, may be used instead of directly copying the table.
  - The complete *ACAM GHG & Climate Change Report* for all action alternatives must be included in the air quality appendix in the EA or EIS.

If the Insignificance Assessment indicates **one or more years are significant (Exceedance = Yes)**:

- For CATEX Actions:
  - Document the specific and General Conformity exemption (if applicable) on the AF Form 813.
  - Attach a copy of the *ACAM GHG & Climate Change Report* for all action alternatives.
- For EA or EIS Actions:
  - The GHG and Climate Change section of an EA or EIS should include copies (from the *ACAM GHG & Climate Change Report*) of the *GHG Emissions Quantification Table*, *Relative Significance Assessment*, and *Climate Change Evaluation*. A summary table, comparing each, may be used instead of directly copying the tables from the *ACAM GHG & Climate Change Report*.
  - The complete *ACAM GHG & Climate Change Report* for all action alternatives must be included in the air quality appendix in the EA or EIS

1.3.3 Relative Significance Assessment

A Relative Significance Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (i.e., global, national, and regional) and the degree (intensity) of the proposed action's effects. The Relative Significance Assessment provides real-world context and allows for a reasoned choice against alternatives through a relative comparison analysis. The analysis weighs each alternative's annual net change in GHG emissions proportionally against (or relative to) global, national, and regional emissions.

The action's surroundings, circumstances, environment, and background (context associated with an action) provide the setting for evaluating the GHG intensity (impact significance). From an air quality perspective, the context of an action is the local area's ambient air quality relative to meeting the NAAQSs, expressed as attainment, nonattainment, or maintenance areas (this designation is considered the attainment status). GHGs are non-hazardous to health at normal ambient concentrations and, at a cumulative global scale, action-related GHG emissions can only potentially cause warming of the climatic system. Therefore, generally, the action-related GHGs have an insignificant impact to local air quality.

However, the affected area (context) of GHG/climate change is global. Therefore, the intensity or degree of the proposed action's GHG/climate change effects are gauged through the quantity of GHG associated with the action as compared to a baseline of the state, U.S., and global GHG inventories. Each action (or alternative) has significance, based on their annual net change in GHG emissions, in relation to or proportionally to the global, national, and regional annual GHG emissions.

To provide real-world context to the GHG and climate change effects on a global scale, an action's (or alternative's) net change in GHG emissions is compared relative to the state (where action will occur) and U.S. annual emissions. While the relative emissions comparison of the action and alternatives must be manually tabulated, ACAM automatically performs a Relative Significance Assessment against the state and U.S. annual emissions for an action (or alternative). See the following table for an example of a relative comparison of an action's net change in GHG emissions vs. state and U.S. projected GHG emissions for the same time period.

Example ACAM, GHG Relative Significance Table

Total GHG Emissions (mton)					
		CO2	**CH4**	**N2O**	**CO2e**
2023-2044	State Total	2,223,499,191	13,807,998	312,463	2,237,619,652
2023-2044	U.S. Total	103,214,132,384	553,337,752	31,477,952	103,798,948,088
2023-2044	Action	390,936	19.597422	2.465785	449,692
Percent of State Totals		0.01758204%	0.00014193%	0.00078915%	0.02009690%
Percent of U.S. Totals		0.00037876%	0.00000354%	0.00000783%	0.00043323%

The U.S. and State's GHG emissions estimates are based on a five-year average (2016 through 2020) of individual state-reported GHG emissions. (NOAA 2022)

For further perspective at a global context, ACAM also automatically compares the action-related lifecycle GHG emissions value to the total global GHG emissions for the same time period as the percentage of total global GHG. The global emissions value is based on the U.S.'s 13.4% of global GHG annual emissions. (CCES 2018) Therefore, for the example above:

Global GHG emissions (same time-period) = 774,619,015,582 metric tons (mton)
Action GHG emissions (same time-period) = 0.000058% of the global GHG emissions

1.4 Climate Change Evaluation

The 2023 CEQ GHG Guidance requires addressing the potential climate change effects of proposed actions and providing additional context for GHG emissions using SC GHG estimates. (CEQ 2023) An action's lifetime (from the start to the completion of an action) is different than the lifetime of the effects of action-relate GHG. The 2023 CEQ GHG Guidance recommends quantifying a proposed action's projected GHG emissions or reductions for the expected lifetime of the action and the action's environmental effects over the lifetime of the effects. Agencies should quantify the reasonably foreseeable gross GHG emissions increases and gross GHG emission reductions for the proposed action, no action alternative, and any reasonable alternatives over their projected lifetime, using reasonably available information and data. (CEQ 2023) SC GHG estimates provide context to the action's environmental effects over the lifetime of the effects.

In conducting a Climate Change Evaluation, be sure to apply the NEPA/CEQ principles:

- GHGs potentially cause warming of the climatic system at a cumulative global scale which, in turn, causes climate change; therefore, the context of a climate change assessment is only global.
- The intensity or degree of the proposed action's climate change effects are indirectly gauged through the quantity of GHG associated with the action.
- Perform the climate change assessments commensurate (proportional) with the anticipated quantity of projected GHG emissions.

To evaluate the effects of climate change on a proposed action, two interrelated elements (assessments) are performed: 1) the impact of a proposed action on climate change, and 2) the impact of climate change on the action's environment.

1.4.1 Impact of Proposed Action on Climate Change

The impact of a proposed action on climate change is indirectly addressed through first estimating the theoretical SC GHG and then putting the values into a global context by performing a relative comparison of SC GHG.

1.4.1.1 Theoretical SC GHG Estimate

On a global scale, the potential climate change effects of an action are indirectly addressed and put into context through providing the theoretical SC GHG associated with an action and its alternatives. The SC GHG is an administrative and theoretical tool intended to provide additional context to a GHG's potential impacts through approximating the long-term monetary damage that may result from GHG emissions effect on climate change. It is important to note that the SC GHG is a monetary quantification, in 2020 U.S. dollars, of the theoretical economic damages that could result from emitting GHGs into the atmosphere.

In the 2023 GHG Guidance, CEQ suggests providing additional context for GHG emissions through using theoretical SC GHG estimates, "to translate climate impacts into the more accessible metric of dollars, allow decision makers and the public to make comparisons, help evaluate the significance of an action's climate change effects, and better understand the tradeoffs associated with an action and its alternative."

All SC GHG Assessments are automatically performed in ACAM. The SC GHG estimates are derived using the methodology and discount factors in the "Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990," released by the Interagency Working Group on Social Cost of Greenhouse Gases (IWG SC GHGs) in February 2021.

Based on the annual net change in speciated GHGs and CO2e emissions associated with an action (or alternative) calculated in ACAM, the speciated IWG Annual SC GHG Emission associated with an action (or alternative) are first estimated as annual unit cost (cost per metric ton, $/mton). Results of the annual IWG Annual SC GHG Emission Assessments are tabulated in the IWG Annual SC GHG Cost per Metric Ton Table in the *ACAM GHG & Climate Change Report* (see example table below).

Example ACAM, IWG Annual SC GHG Emission table

IWG SC GHG Discount Factor: 2.5%

IWG Annual SC GHG Cost per Metric Ton ($/mton [In 2020 $])			
YEAR	**CO2**	**CH4**	**N2O**
2023	$80.00	$2,100.00	$29,000.00
2024 [SS Year]	$82.00	$2,200.00	$29,000.00
2025	$83.00	$2,200.00	$30,000.00
2026	$84.00	$2,300.00	$30,000.00
2027	$86.00	$2,300.00	$31,000.00

Then ACAM automatically estimates the action-related SC GHG by calendar-year for the projected action's lifecycle. Annual estimates are found by multiplying the annual emission for a given year by the corresponding IWG Annual SC GHG Emission value (see example table above). The Action-related SC GHG results are tabulated in the Action-Related Annual SC GHG Table in the *ACAM GHG & Climate Change Report* (see example table below).

Example ACAM, Action-Related Annual SC GHG Table

Action-Related Annual SC GHG ($K/yr [In 2020 $])				
YEAR	**CO2**	**CH4**	**N2O**	**GHG**
2023	$1,308.08	$1.72	$2.99	$1,312.79
2024 [SS Year]	$1,462.67	$1.97	$3.26	$1,467.90
2025	$1,480.50	$1.97	$3.38	$1,485.85
2026	$1,498.34	$2.06	$3.38	$1,503.77
2027	$1,534.02	$2.06	$3.49	$1,539.56

1.4.1.2 Relative Comparison of SC GHG

To provide additional real-world context to the potential climate change impact associated with an action, a Relative Comparison of SC GHG Assessment is also automatically generated by ACAM. While the SC GHG estimates capture an indirect approximation of global climate damages, the Relative Comparison of SC GHG Assessment provides a better perspective from a regional and global scale.

The Relative Comparison of SC GHG Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (i.e., global, national, and regional) and the SC GHG as the degree (intensity) of the proposed action's effects. The Relative Comparison Assessment provides real-world context and allows for a reasoned choice among alternatives through a relative contrast analysis which weighs each alternative's SC GHG proportionally against (or relative to) existing global, national, and regional SC GHG.

The below table provides an example of a relative comparison between an action's SC GHG vs. state and U.S. projected SC GHG for the same time period.

Example ACAM, SC GHG Comparison Table

Total SC-GHG ($K [In 2020 $])					
		CO2	**CH4**	**N2O**	**GHG**
2023-2044	State Total	$209,615,332.86	$37,846,466.97	$10,907,791.31	$258,369,591.14
2023-2044	U.S. Total	$9,730,277,752.93	$1,516,648,474.80	$1,098,866,688.00	$12,345,792,915.73
2023-2044	Action	$36,875.86	$53.76	$86.13	$37,015.76
Percent of State Totals		0.01759216%	0.00014205%	0.00078965%	0.01432667%
Percent of U.S. Totals		0.00037898%	0.00000354%	0.00000784%	0.00029982%

The U.S. and State's Annual SC GHG (in 2020 U.S. dollars) are estimated by year for the projected action's lifecycle. Annual SC GHG estimates are found by multiplying the U.S. and State's annual five-year average GHG emissions by the corresponding IWG Annual SC GHG Cost per Metric Ton value for a given year.

For further perspective at a global context, ACAM also automatically compares the action-related lifecycle SC GHG value to the total global SC GHG for the same time period as the percentage of total global SC GHG. The global emissions value is based on the U.S.'s 13.4% of global GHG annual emissions. (CCES 2018) Therefore, for the example above:

Global SC GHG (same time period) = $92,132,782,953.00
Action SC GHG (same time period) = 0.000040% of the global GHG emissions

1.4.2 Qualitative Impact of Climate Change on a Proposed Action

Note: The effects of climate change on a proposed action and its environmental impacts is not directly or solely air quality related; therefore, this section is optional for air quality impact assessments. However, these steps may be of use in assessing the effects of climate change on other non-air quality resources.

The DAF is responsible for meeting the CEQ's guidance "to the fullest extent possible" per 40 CFR 1500.3; however, CEQ's Regulations (40 CFR Parts 1500-1508) make it clear that one should apply the *rule of reason* and the *concept of proportionality* (regulatory speak for "keep it simple"). Under the rule of reason, actions/alternatives with greater positive features and least negative effects weigh higher (more positive) than actions/alternatives with less positive features and greater negative effects. Under the concept of proportionality, actions/alternatives with the least quantity of projected GHG emissions weigh higher (more positive and desirable) than actions/alternatives with higher quantity of projected GHG emissions. Therefore, the effort that must be put into assessing the effects of climate change on a proposed action and its environmental impacts needs to be proportional to the action's potential to affect climate change and vice versa.

The earth's global temperature has risen by 1.5°F over the past century and is projected to continue to rise. Small changes in the global temperature over time can translate into large and potentially dangerous shifts in climate and weather on a global scale and even at the state level. Many states have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves.

Under this part of the assessment, current and future potential impacts that climate change could have on the proposed action (both during construction and future steady state) are identified and qualitatively addressed. These impacts are generally needed for proper design and examples include: the need for shading and air conditioning at the guard posts, flooding, and storm water drainage, continued drinking water supply, etc.

While assessing climate change's impact on a proposed action is a good idea for early planning and design, it is not necessarily included in a traditional NEPA analysis. NEPA was implemented to ensure potential environmental effects of proposed Federal agency actions are assessed, not the reverse of the impacts of the environment on the action. Nonetheless, the DAF is still responsible for meeting CEQ's guidance. Therefore, assessing (as discussed above) climate change's impact on a proposed action is consistent with this requirement and prudent practice to ensure proper planning and design of the action to prevent mission failure in the future.

The following steps are suggested for addressing the potential impacts that climate change could have on the proposed action:

1.4.2.1 Step 1, Identify State-Specific Potential Impacts

Under this step, distinguish the potential climate change impacts (e.g., changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves) that are applicable to the specific state that the action will occur in.

The EPA has developed state-specific factsheets, *What Climate Change Means for Your State*, which identifies and discusses potential climate change impacts specific to the conditions and circumstances of each state. Therefore, to simplify the identification of potential climate change impacts for the specific action, start by downloading the EPA factsheet for the state within which the action will occur. These factsheets can be found at https://www.aqhelp.com/AQdocs.html.

Example State-Specific Climate Change Factsheet

EPA United States Environmental Protection Agency

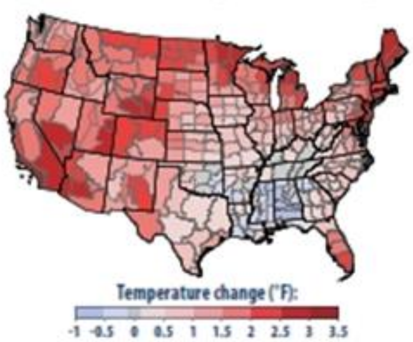
August 2016
EPA 430-F-16-003

What Climate Change *Means for* Alabama

In the coming decades, **Alabama** will become warmer, and the state will probably experience more severe floods and drought. Unlike most of the nation, Alabama has not become warmer during the last 50 years. But soils have become drier, annual rainfall has increased in most of the state, more rain arrives in heavy downpours, and sea level is rising about one inch every eight years. Changing the climate is likely to increase damages from tropical storms, reduce crop yields, harm livestock, increase the number of unpleasantly hot days, and increase the risk of heat stroke and other heat-related illnesses.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree (F) during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others. While most of the earth warmed, natural cycles and sulfates in the air cooled Alabama. Sulfates are air pollutants that reflect sunlight back into space. Now sulfate emissions are declining, and the factors that once prevented the state from warming are unlikely to persist.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.



Changing temperatures in the last century. While most of the nation has warmed, Alabama and a few other states have cooled. Source: EPA, Climate Change Indicators in the United States.

Rising Seas and Retreating Shores

Sea level is rising more rapidly in Alabama than most coastal areas because the land is sinking. If the oceans and atmosphere continue to warm, sea level along the Alabama coast is likely to rise eighteen inches to four feet in the next century. Rising sea level submerges wetlands and dry land, erodes beaches, and exacerbates coastal flooding.

Coastal Storms, Homes, and Infrastructure

Tropical storms and hurricanes have become more intense during the past 20 years. Although warming oceans provide these storms with more potential energy, scientists are not sure whether the recent intensification reflects a long-term trend. Nevertheless, hurricane wind speeds and rainfall rates are likely to increase as the climate continues to warm.

Whether or not storms become more intense, coastal homes and infrastructure will flood more often as sea level rises, because storm surges will become higher as well. Rising sea level is likely to increase flood insurance rates, while more frequent storms could increase the deductible for wind damage in homeowner insurance policies. Many cities, roads, railways, ports, airports, and oil and gas facilities along the Gulf Coast are vulnerable to the combined impacts of storms and sea level rise. People may move from vulnerable coastal communities and stress the infrastructure of the communities that receive them.

Hurricane Katrina's storm surge destroyed homes and roads on Dauphin Island in 2005. Credit: FEMA.

Precipitation and Water Resources

Annual precipitation in Alabama has increased 5 to 10 percent since the first half of the 20th century. Although rainfall during spring is likely to increase during the next 40 to 50 years, the total amount of water running off into rivers or recharging ground water is likely to decline 2.5 to 5 percent, as increased evaporation offsets the greater rainfall. Droughts are likely to be more severe, because periods without rain may be longer and very hot days will be more frequent.

Flooding, River Transportation, and Hydroelectric Power

Flooding is becoming more severe in the Southeast. Since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the Southeast, and the trend toward increasingly heavy rainstorms is likely to continue. While some rivers such as the Tennessee have dams to help prevent flooding, other rivers either have no dams or have dams with too little capacity to significantly reduce flooding. Heavy rains have caused the Pea River to flood Elba several times, and the Alabama River flooded two thousand homes in Selma and Montgomery during 1990.

Droughts create a different set of challenges. When reservoirs release water for navigation along the Tennessee or Black Warrior rivers, too little water may be available for lake recreation or hydropower. Low flows from drought occasionally limit navigation along the Alabama River. During severe droughts in the Mississippi River's watershed, however, navigation can potentially increase on the Tennessee-Tombigbee Waterway, which provides an alternative route to the Gulf of Mexico.

Flooding of a small stream in June 2014 destroyed this roadbed in Foley. Credit: Patsy Lynch, FEMA.

Droughts also affect the amount of electricity that Alabama Power and the Tennessee Valley Authority (TVA) can produce from their hydroelectric dams, which account for about 8 percent of the electricity produced in the state. During the 2007 drought, total production from the TVA's hydroelectric plants fell by more than 30 percent, which forced the TVA to meet customer demand by using more expensive fuel-burning power plants.

Agriculture and Forest Resources

Changing the climate will have both harmful and beneficial effects on farming. Seventy years from now, Alabama is likely to have 30 to 60 days per year with temperatures above 95°F, compared with about 15 days today. Even during the next few decades, hotter summers are likely to reduce yields of corn. But higher concentrations of atmospheric carbon dioxide increase crop yields, and that fertilizing effect is likely to offset the harmful effects of heat on soybeans, cotton, wheat, and peanuts—if adequate water is available. More severe droughts, however, could cause crop failures. Higher temperatures are also likely to reduce livestock productivity, because heat stress disrupts the animals' metabolism.

Higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Alabama, although the composition of trees in the forests may change. More droughts would reduce forest productivity, and climate change is also likely to increase the damage from insects and disease. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors. Forests cover more than two-thirds of the state. Oak, hickory, and white pine trees tend to be most common in the northern part of the state, while loblolly pines are more common in the southern forests. As the climate warms, forests in southern Alabama are likely to have more white pines and oaks, and fewer loblolly pines.

Human Health

Hot days can be unhealthy—even dangerous. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. High air temperatures can cause heat stroke and dehydration and affect people's cardiovascular and nervous systems. Warmer air can also increase the formation of ground-level ozone, a key component of smog. Ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease. EPA and the Alabama Department of Environmental Management have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will become more difficult.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States*. Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.

Each state-specific factsheet is two pages long with an introduction on the front page and a list of specific potential climate change impacts within a blue background. An example of the EPA's "*What Climate Change Means for Your State"* factsheet for Alabama is provided in *Example State-Specific Climate Change Factsheet*. In this example, the specific potential climate change impacts for Alabama are: Rising Seas and Retreating Shores; Coastal Storms, Homes, and Infrastructure; Precipitation and Water Resources; Flooding, River Transportation, and Hydroelectric Power; Agriculture and Forest Resources, and Human Health.

1.4.2.2 Step 2, Identify Location-Specific Potential Impacts

Under this step, further differentiate location-specific potential climate change impacts from the list of state-specific potential climate change impacts identified in Step 1 above. Simply apply the rule of reason and the concept of proportionality (regulatory speak for "keep it simple"). Most, if not all, of the state-specific potential impacts can be eliminated as "not applicable" to the location of the proposed action.

For example, if the action will occur inland on a DAF installation within Alabama, the state-specific list above can simply be distilled down to only:

- Precipitation and Water Resources
- Flooding
- Forest Resources
- Human Health

1.4.2.3 Step 3, Assess Location-Specific Potential Impacts

Under this step, perform a cursory qualitative (interpretive) assessment of the differentiated location-specific potential climate change impacts from the list generated in Step 2 above. Again, the goal is to keep it simple while addressing each potential impact. The assessment should generally be explanatory in nature, unless location-specific quantitative (measures) data is readily available. Ensure the assessment includes a discussion on the probability of each impact occurring and any efforts the DAF may take to mitigate or alleviate the impact.

1.4.2.4 Step 4, Impact of Climate Change on the Action's Environmental Impacts

Under this step, current and future potential environmental impacts attributed to the action that are exacerbated (i.e., cause to worsen) by climate change are identified and qualitatively addressed. These impacts are generally needed for proper planning and design. Examples include impacts on water resources, Native Americans, forests and other ecosystems, erosion, etc. This assessment is effectively a continuation of the steps described in Section 6.4.1, *Impact of Climate Change on a Proposed Action*, above.

1.4.2.5 Step 5, Assess Location-Specific Potential Exacerbating Impacts

Again, this is a cursory qualitative (interpretive) assessment of the differentiated location-specific potential climate change impacts from the list generated in Step 2 above (Note that only the potential impacts identified in Step 2 are addressed). And, once again, the goal is to keep it simple while addressing each potential impact.

The assessment should generally be explanatory in nature unless location-specific quantitative (measures) data is readily available. Ensure the assessment includes a discussion on the conditions that climate change is exacerbating (i.e., worsening) the impacts of the action, the probability of each impact occurring, and any efforts the DAF may take to mitigate or alleviate the impact of climate change exacerbating (i.e., worsening) the impacts of the DAF action.

1.5 Environmental Justice (EJ)

Climate change is anticipated to increase a community's vulnerability to other environmental impacts, further exacerbating EJ concerns. The future anticipated effects of climate change include more frequent and intense heat waves, longer fire seasons, more severe wildfires, degraded air quality, increased drought, greater sea-level rise, an increase intensity and frequency of extreme weather events, harm to water resources, harm to agriculture, ocean acidification, and harm to wildlife and ecosystems. According to CEQ, the effects of climate change are likely to fall disproportionately on vulnerable communities, including communities of color, low-income communities, Tribal Nations, and Indigenous communities with EJ concerns. (IPCC 2021 & CEQ 2023)

1.5.1 GHG Air Quality EJ Concerns

GHGs are generally non-hazardous to health at normal ambient concentrations and can only potentially cause warming of the climatic system on a cumulative global scale. Therefore, the action-related GHGs generally have no significant impact on local air quality.

1.5.2 Climate Change EJ Concerns

When assessing EJ considerations in NEPA analyses, agencies should use the scoping process to identify potentially affected communities and provide early notice of opportunities for public engagement. This is important for all members of the public and stakeholders, but especially for EJ communities, including those who have suffered disproportionate public health or environmental harms and those who are at increased risk for climate change-related harms.

When assessing cumulative effects, agencies should also consider whether certain communities experience disproportionate cumulative effects, thereby raising EJ concerns. Federal agencies, like the DAF, should identify any communities with environmental justice concerns, including communities of color, low-income communities, and Tribal Nations and Indigenous communities, impacted by the proposed action, and consider how impacts from the proposed action could potentially amplify climate change-related hazards.

AFCEC/CZTQ is developing an EJ tool that will provide DAF installation specific EJ data including EJ index, block groups, demographic indices for block groups, etc. Until the DAF's EJ Tool is developed, it is recommended to use the EPA's EJScreen tool.

EJScreen is the EPA's new environmental justice mapping and screening tool that is based on nationally consistent data and an approach that combines environmental and demographic indicators in maps and reports. EJScreen can be assessed at: https://www.epa.gov/ejscreen.

1.6 References

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