Picture of Choctaw Nation of Oklahoma Capital grounds Red Warrior "Tvshka Homma" Statue

Priority Climate Action Plan
Choctaw Nation of Oklahoma

Prepared for
United States Environmental Protection Agency (EPA)
Climate Pollution Reduction Grant

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Executive Summary

The U. S. Environmental Protection Agency (EPA) provided grant funding to the Choctaw Nation of Oklahoma (CNO) to develop a Priority Climate Action Plan (PCAP) and a Comprehensive Climate Action Plan (CCAP). Authorized under section 60114 of the Inflation Reduction Act (IRA), the Climate Pollution Reduction Grants (CPRG) program provides grants to tribes and territories to develop and implement ambitious plans for reducing greenhouse gas (GHG) emissions and other harmful air pollution. The PCAP is to include proposed priority reduction measures for submittal. The PCAP provides the basis for eligible entities to pursue Climate Pollution Reduction Grant implementation funding from the EPA.

The purpose of the Priority Climate Action Plan (PCAP) is to provide the Choctaw Nation of Oklahoma with high level recommendations for projects and programs that the Nation can implement to reduce GHG emissions throughout the reservation boundaries. The focus will be in two sectors, energy generation reduction and solid waste management. This plan will indicate reduction measures needed in the attempt to reduce GHGs throughout the reservation boundaries.

The PCAP was led by CNO Environmental Protection Service (EPS) team members as well as minor consultation with outside consultant for emissions calculations. CNO EPS looked at all the counties in the reservation to identify priorities and needs in all the communities as well as gaining data and knowledge aiding in the development of this PCAP.

There are two phases associated with the CPRG program. Phase 1 of the CPRG program is focused on developing a plan to design climate action plans that incorporate a variety of measures to reduce GHG emissions from six key sectors (electricity generation, industry, transportation, buildings, agriculture/natural and working lands, and waste management). Phase 2 of the CPRG program is a separate grant and is aimed at the implementation phase of identified reduction measures.

Choctaw Nation of Oklahoma's road to GHG emissions reductions is outlined in this Priority Climate Action Plan. CNOs PCAP will result in reduced electricity consumption, significant reductions in waste, as well as improved overall environmental and health benefits.

CNO's PCAP process included:

- ✓ **Data Coordination**
- ✓ **GHG Inventory Development**
- ✓ **Select Priority Measures**
- ✓ **Environmental and Health Benefits Analysis**

1. Introduction

1.1 CPRG Overview

Choctaw Nation of Oklahoma, with support from the EPA via funding under the CPRG program, endeavors to better specify climate impacts within the CNO Reservation, as well as all interactions with GHG emissions. This understanding enables strategic planning for the sustainable development and improvement of the Choctaw Nation reservation, both human and environmental.

The Choctaw Nation of Oklahoma is the third largest Indian Nation in the United States. The Choctaw Nation reservation, located in the southeastern portion of Oklahoma shares borders with the States of Texas and Arkansas, covers approximately 11,000 square miles and encompasses eight entire counties (Atoka, Choctaw, Haskell, Latimer, Le Flore, McCurtain, Pittsburg, Pushmataha) and portions of five counties (Bryan, Coal, Hughes, Johnston, Pontotoc).

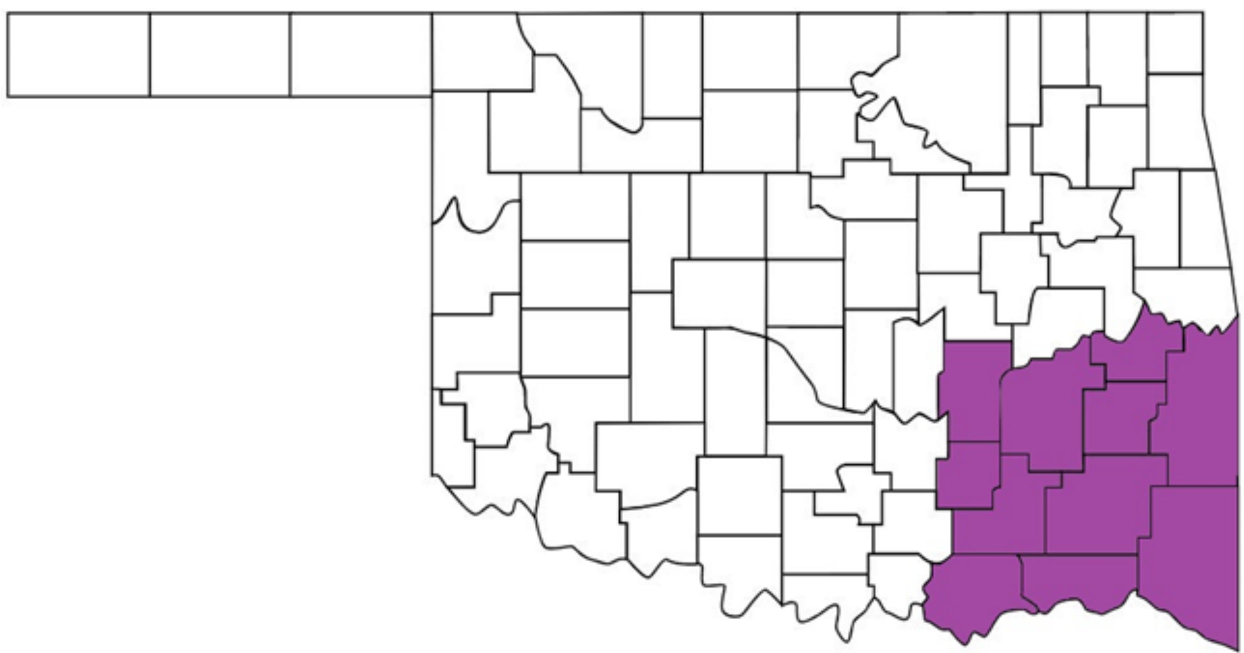

Figure 1. State of Oklahoma geographic profile of Choctaw Nation

Choctaw Nation of Oklahoma
District Map

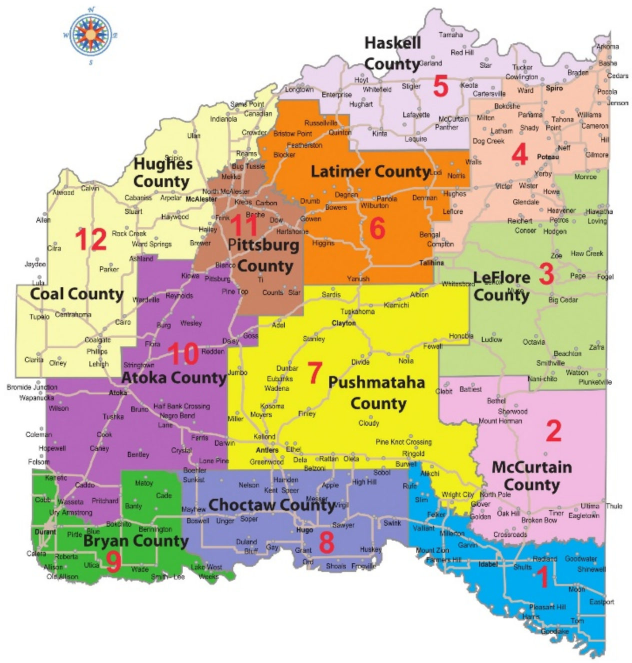

Figure 2. - Choctaw Nation of Oklahoma territory boundaries within Oklahoma

The Choctaw Nation of Oklahoma is a sovereign nation with the inherent right to self-governance. CNO has its own government and constitution which provides for an executive, legislative and judicial branch of government and consists of elected officials. Tribal affairs and decisions are the responsibility of an elected Chief as well as twelve Tribal Council positions. Considerable services are available to Tribal members including, but not limited to, cultural programs, healthcare, housing assistance, veterans' benefits, education, and economic development. Choctaw Nation's commitment to sustainability, cultural preservation, and the overall well-being of the people and lands is reflected in the current progress and future goals of the Nation.

The Choctaw Nation's vision of "Living out the Chahta spirit of Faith, Family and Culture" is evident as CNO fosters a sustainable eco-friendly future through its environmental programs. The aim is to improve the overall quality of the tribal reservation lands. Through the Inflation Reduction Act of 2022, the Choctaw Nation can achieve objectives similar to the EPA.

CNO will seek to achieve objectives such as:

- Tackling climate pollution by reducing energy consumption.
- Attempting to deliver cleaner air by reducing harmful air pollutants in the places that Tribal members and non-tribal members alike live, play, work, attend school, etc.
- Addressing environmental injustices within the reservation boundaries improving human health and the environment.

The overall intent for the CPRG program is to communicate knowledge and accountability regarding emissions, climate pollution, and environmental injustice throughout the reservation. The CPRG program also aims to gain support to proactively prepare and meet the need for changes to ensure the wellbeing and continuity of our communities and to take care of our lands, waters, natural resources, as well as our non-human kin and nature.

1.2 PCAP Overview

Climate action planning is an important step towards slowing the negative effect of climate change. Climate change has caused an increasing number of days with extreme heat, significant drought conditions, air pollution, and other impacts within the boundaries of the Choctaw Nation reservation. Tribal nations are some of the more vulnerable communities to the impacts of climate change. Choctaw Nation is committed to planning and implementing climate change pollution reduction actions along with Tribal sustainability goals.

Choctaw Nation developed a PCAP that addresses key deliverables required for Phase I CPRG grant requirements. CNO has completed the following elements of the PCAP:

- GHG Inventory
  - A baseline 2023 GHG inventory
- Quantified GHG reduction measures
  - GHG reduction measures for various sectors
- Benefits Analysis
  - An analysis of GHG emissions for the co-benefit of a reduction in air pollution throughout the Choctaw Nation Reservation.
- Review of Authority to implement

1.3 Approach to Developing the PCAP

The Choctaw Nation of Oklahoma developed this PCAP out of a need to address issues with air quality and a reduction in emissions within the reservation boundaries. Weekly meetings were held to discuss the needs of the Tribe along with investigation processes to be completed. While the tribe has certain measures already in place for addressing some emissions issues, this PCAP will help the Environmental Protection Service to clarify the needs of the Tribe and to further mitigate future issues caused by emission sources throughout the reservation boundaries. Various energy resources were utilized to gather data on energy consumption. CNO was able to utilize various other public inventory tools in this information gathering.

Energy generation statistics were gathered and utilized in the initial GHG inventory emissions data capture. The report shows the annual energy usage by sector across the reservation boundaries. These data values were used to calculate the GHG emissions.

Implementation of any emissions reduction measures within the Choctaw Nation of Oklahoma will rely on the inherent knowledge of its Tribal leaders, any partnerships garnered from other Tribes in the region, as well as utilizing partnerships with city, state and federal agencies. The administrative processes below will lay the foundation for the future of the CNO and its goals of emissions reduction.

The Choctaw Nation will:

- Develop partnerships to gain the trust and collaboration of local entities. Often local utility companies, building owners, landowners and other key partners are left out of the discussions. We aim to garner this trust through these trusted partnerships.
- Obtain Tribal Council approvals and participation in this project by passing resolutions to provide support as well as grant writing. The expertise in management will also lend support to this project.
- Gain support and commitment from local communities to highlight the importance of the project as well as any community needs. A commitment from local communities allows CNO to lend a hand in times of need.

1.4 Scope of the PCAP

Climate change refers to significant changes in the global temperatures and weather patterns over time. It is understood that climate change is a natural consequence of the current trends driven by detrimental human activities. These activities include releases of significant quantities of greenhouse gases (GHGs) into the atmosphere. These gases trap heat from the sun which causes the average temperature on earth to rise. This PCAP includes inventories that cover emissions from all counties within the Choctaw Nation reservation boundaries.

CNO realized that energy generation, energy conservation. and waste management were the measures currently found as relevant for further investigation throughout the reservation. Tribal communities often face a disproportionate challenge regarding environmental issues such as pollution and climate change. These challenges often further existing economic and social challenges. Emissions reductions are often challenging when faced with these issues.

The Choctaw Nation of Oklahoma projects considered in this PCAP are projected to be in motion by the end of 2025. While there is no hard timeline when we will start seeing results, we estimate that measures in place at the end of 2025 should be fully implemented within five (5) years of project inception.

2. Tribal/Territorial Organization and Development Team

The Choctaw Nation of Oklahoma Environmental Protection Service (EPS) department works to develop and implement programs and processes in the environmental sustainability of the Tribe. This PCAP was developed by EPS Staff as well as minor outside consultation. Decision making authority has been through EPS Staff as well.

Team members were as follows:

Tye Baker, Senior Director Environmental Protection Service
Tracy Horst, Director Environmental Compliance
Aimee McClure, Environmental Specialist II, Environmental Compliance
Nicole Morrison, Environmental Coordinator I, Environmental Compliance

Collaborations within CNO were with the Utility Authority (CNUA) department. CNUA was able to provide critical information from utility companies. This energy consumption information aided in the calculations used in the development of reduction measures. Collaboration with an outside consultant allowed for the calculations to be made real time. These calculations aided in the final consumption data sets utilized in the reduction measures development.

3.1 PCAP Elements

3.1.1 Greenhouse Gas Inventory

To fulfill the requirements of the first subtask established in the approved QAPP, CNO developed a GHG inventory of major GHG emission source categories within the thirteen (13) counties under CNO's jurisdiction, including:

- ✓ All of Atoka County
- ✓ All of Choctaw County
- ✓ All of Haskell County
- ✓ All of Latimer County
- ✓ All of Le Flore County
- ✓ All of McCurtain County
- ✓ All of Pittsburg County
- ✓ All of Pushmataha County
- ✓ Parts of Bryan County
- ✓ Parts of Coal County
- ✓ Parts of Hughes County
- ✓ Parts of Johnson County
- ✓ Parts of Pontotoc County

CNO has chosen to develop the GHG inventory for the year 2023 as the base year. The 2023 base year is representative and reflective of CNO's general emissions pattern. The inventory was created by using publicly available data for applicable emission categories. The data was then scaled to CNO's activity in 2023 using activity data such as population or area (See Appendix A). The GHG inventory quantified the annual estimates for primary GHGs such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) and are reported in carbon dioxide equivalent (CO_2e) by applying their respective CO_2e global warming potential (GWP) factors.[1]

The inventory organized emissions based on the source categories established in the EPA's Tribal – GHG Inventory Tool (TGIT), which are further outlined in the following section. The estimates provided in the inventory are used to establish a baseline for CNO's contribution to air quality and will be used as a tool for establishing air pollution reduction measures. This data may not always correspond to the 2023 base year and often does not align with the CNO boundary. To address this, the data was adjusted using activity metrics, such as population data or area within the CNO boundary for the 2023 base year.[2]

3.1.2 Emission Source Categories Evaluated

The GHG inventory was organized based on the seven (7) emission categories established within the TGIT, which the EPA has deemed to have significant impacts on air emissions. These categories include:

- Stationary combustion;
- Mobile units;
- Electricity;
- Urban forestry;
- Wastewater treatment systems;
- Agriculture; and
- Solid waste.

When available, each emission source category was further organized into either:
- Sectors (residential, commercial/institutional, industrial, and energy generation); or
- Counties.

These sector or county groupings provide CNO with greater insight into the breakdown of emissions for each category.

3.1.3 Calculation Methodology

3.1.3.1 Stationary Combustion

The stationary combustion emission category was organized into sectors (residential, commercial/institutional, industrial, and energy generation) based on the publicly available data.

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[1] GWPs per *IPPC AR6 7SM Report, Table 7.SM.6*. Accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

[2] Population data and areas for each county within CNO boundary are obtained from the United States Census Bureau. For counties that extend beyond the CNO boundary, areas within the CNO boundary are estimated using measurements from Google Earth. Available at https://www.census.gov/quickfacts/.

Stationary combustion fuel consumption data (natural gas and propane) for the residential sector was obtained from the U.S. Energy Information Administration Residential Energy Consumption Survey (EIA RECS) for the State of Oklahoma for the year 2020.[3] The natural gas and propane consumption data were scaled to the CNO boundary for the 2023 base year using the population data. GHG emissions were then calculated using the consumption data and emission factors obtained from Tables C-1 and C-2 of 40 CFR Part 98 Subpart C.

There is no publicly available data for the commercial/institutional sector. As a result, emissions calculations for this sector were not performed.

Emission data for the industrial and energy generation sectors were obtained from the U.S. EPA Facility Level Information on Greenhouse gases Tool (FLIGHT) for the year 2022.[4] FLIGHT provided the facility's CO_2e emissions and locations for facilities required to report GHG. The data was additionally organized at the county level, allowing CNO to filter for emissions from facilities within the CNO boundaries. Data was then scaled using population data to the 2023 base year.

3.1.3.2 Mobile Units

The mobile unit emission category was organized into counties based on the publicly available data. Emissions information were sourced from the U.S. EPA's National Emissions Inventory (NEI) tool, which compiles nationwide air emissions every three years by collaborating with state, local, and tribal agencies for criteria pollutants, GHG, and hazardous air pollutants (HAP).[5] The most recent emissions, for year 2020, were pulled for each relevant county within the CNO boundary. As the NEI does not provide sector-specific data, emissions calculations were performed only at the county level. The data was then scaled into CNO boundary for the 2023 base year using the population activity.

In addition to county-level emissions, emissions were also summarized based on vehicle and fuel types as follows:

- Highway vehicles, organized by fuel type;
    - Natural gas (CNG);
    - Diesel;
    - Electricity;
    - Ethanol (E-85); and
    - Gasoline.

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[3] U.S. EIA RECS, "CE2.1.ST Annual household site fuel consumption in United States homes by state - totals and averages, 2020." Available at https://www.eia.gov/consumption/residential/data/2020/state/pdf/ce2.1.st.pdf

[4] U.S. EPA FLIGHT. Available at: https://ghgdata.epa.gov/ghgp/main.do. FLIGHT data is per facility and is sorted by County. County emissions is obtained from adding all the facilities within the CNO boundary.

[5] U.S. EPA 2020 National Emissions Inventory Data Retrieval Tool. Available at https://awsedap.epa.gov/public/single/?appid=20230c40-026d-494e-903f-3f112761a208&sheet=5d3fdda7-14bc-4284-a9bb-cfd856b9348d&opt=ctxmenu,currsel

- Off-highway vehicles, organized by fuel type;
    - Natural gas (CNG);
    - Diesel;
    - Gasoline; and
    - Liquified petroleum gas (LPG).
- Pleasure crafts;
- Railroad equipment; and
- Commercial marine vessels.

3.1.3.3 Electricity

The electricity emission category was organized into sectors (residential, commercial/institutional, industrial, and energy generation) based on the publicly available data.

County-level residential, commercial/institutional, and industrial electricity consumption for the 2023 base year was obtained from the National Renewable Energy Laboratory State and Local Planning for Energy (NREL SLOPE) projection.[6] Electricity consumption was scaled to CNO boundaries using available population data. GHG emissions for CO_2, CH_4, and N_2O were calculated using the scaled electricity consumption and emission factors provided from the eGrid Power Profiler for subregion SPSO (SPP South/Texas Panhandle - Oklahoma region).[7]

There is no publicly available data for the energy generation sector. As a result, emissions calculations for this sector were not performed.

3.1.3.4 Urban Forestry

The urban forestry emission category was organized into counties based on the publicly available data.

County-level data for total urban area and % urban area with tree cover for the year 2020 were obtained from the U.S. Forest Service Research Data Archive.[8] The total urban area was scaled into CNO boundaries for 2023 data using the county area activity data. It is assumed that the % urban area with tree cover was the same between 2020 and 2023. Emissions sequestration from urban forestry were then calculated using the method outlined in the TGIT and using the carbon sequestration factor

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6 National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) Tool. Available at: https://maps.nrel.gov/slope/data-viewer?filters=%5B%5D&layer=energy-consumption.net-electricity-and-natural-gas-consumption&year=2020&res=state.

7 eGrid Power Profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO.

8 2020 Total Urban Area and % Urban Area with Tree Cover obtained from the U.S. Forest Service Research Data Archive, Urban Land Cover & Urban Tree Cover datasets. Data accessible here: https://www.fs.usda.gov/rds/archive/catalog/RDS-2021-0075

for the State of Oklahoma. All carbon sequestration from the urban forestry category was assumed to be under the commercial/institutional sector.

3.1.3.5 Wastewater Treatment Systems

The wastewater treatment systems emission category was not able to be organized into counties based on publicly available data.

CNO utilized the emissions from the domestic and industrial treatment/effluent for the 2022 nationwide GHG emissions from the U.S. EPA's Inventory of Greenhouse Gas Emissions and Sinks report.[9] Emissions data was provided for the entire U.S. population and was then scaled using population activity data to only account for CNO populations in the 2023 base year. All emissions from this category were assumed to be part of the commercial/institutional sector.

3.1.3.6 Agriculture

The agriculture emission category was not able to be organized into counties based on publicly available data.

CNO obtained the total fertilizer purchased for the State of Oklahoma from the 2017 Commercial Fertilizer Purchased (1000 kg of Nitrogen) statewide value from the U.S. EPA.[10] The data was then scaled by area activity data to the total fertilizer purchased within the CNO boundary. It is assumed that only area activity data is relevant in scaling the statewide fertilizer throughput and that population changes did not impact the fertilizer throughput. The N_2O emissions were determined using the emission factors and calculation approach as provided in the TGIT. Conservatively, all fertilizer applied was assumed to be synthetic fertilizer, which has the highest emission factors. Additionally, all emissions from the agriculture category were assumed to be under the commercial/institutional sector.

3.1.3.7 Solid Waste

A list of all landfills and their respective annual waste generated within CNO boundaries was developed based on the Annual Tonnage Report from the Oklahoma Department of Environmental Quality (ODEQ).[11] The annual tons of waste reported from 2019 through 2024 were then input into

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[9] Table 7-7 of *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022*. See report here: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

[10] Fertilizer Purchased value obtained from the Nutrient Pollution - Commercial Fertilizer Purchased, Fertilizer nitrogen data table. Data table provides amounts of fertilizer nitrogen (N) purchased by states in individual years; 2017 data utilized for calculation of N_2O emissions. Data table accessible here: https://www.epa.gov/nutrientpollution/commercial-fertilizer-purchased#table1

[11] Annual Tonnage Reported from the Oklahoma Department of Environmental Quality, as reported here: https://www.deq.ok.gov/wp-content/uploads/2021/02/Annual_Tonnage_Reported.pdf

the California Air Resources Board's (CARB's) Landfill Gas Tool.[12] Since the emissions calculation is based on a first-order decay model, historical data was used to provide an accurate estimate of emissions. The CARB Landfill Gas Tool helps landfill owners and operators comply with the applicable California Landfill Methane Regulations but is also a resource for facilities outside of California to determine emissions based on annual production values.

Based on the tool's methodology notes, emissions calculated using this tool were estimated using the equations from Intergovernmental Panel on Climate Change's (IPCC) Mathematically Exact First-Order Decay Model (2006 IPCC Guidelines), based on the percent waste that is degradable anaerobic degradable organic compound % (ANDOC%), which is calculated using the following equation:

$$ANDOC\% = \sum [WIPFRAC\_i \ x \ TDOC\_i \ x \ DANF\_i]$$

Where $WIPFRAC_i$ is the fraction of the i^{th} component in the Waste-in-Place, $TDOC_i$ is the total degradable organic carbon fraction of the i^{th} waste component, and DANFi is the decomposable anaerobic fraction of the i^{th} waste component.

Using this methodology, the tool provided emissions results for both CO_2 and CH_4 emissions for the 2023 base year. All emissions from the solid waste category were assumed to be under the commercial/institutional sector.

There were two additional landfill facilities within the CNO boundaries that did not report their annual waste to ODEQ: International Paper – Valliant Mill Non-Hazardous Industrial Waste (NHIW) Landfill and McAlester Army Ammunition Plant NHIW Landfill. However, emissions data for these two facilities was obtained from the FLIGHT tool for the year 2022.[13] The data was then scaled to CNO boundaries and population metrics for the specific counties where these facilities are located (McCurtain and Pittsburg counties) to reflect the emissions for the 2023 Base Year and to match the CNO boundary.

[12] California Air Resources Board's (CARB) Landfill Gas Tool, using annual tons of waste reported from 2019-2024. See sample workbook here: https://ww2.arb.ca.gov/resources/documents/carbs-landfill-gas-tool.

[13] U.S. EPA FLIGHT. Available at: https://ghgdata.epa.gov/ghgp/main.do. FLIGHT data is per facility and is sorted by County. County emissions are obtained from adding all the facilities within the CNO boundary.

3.1.4 GHG Inventory Results

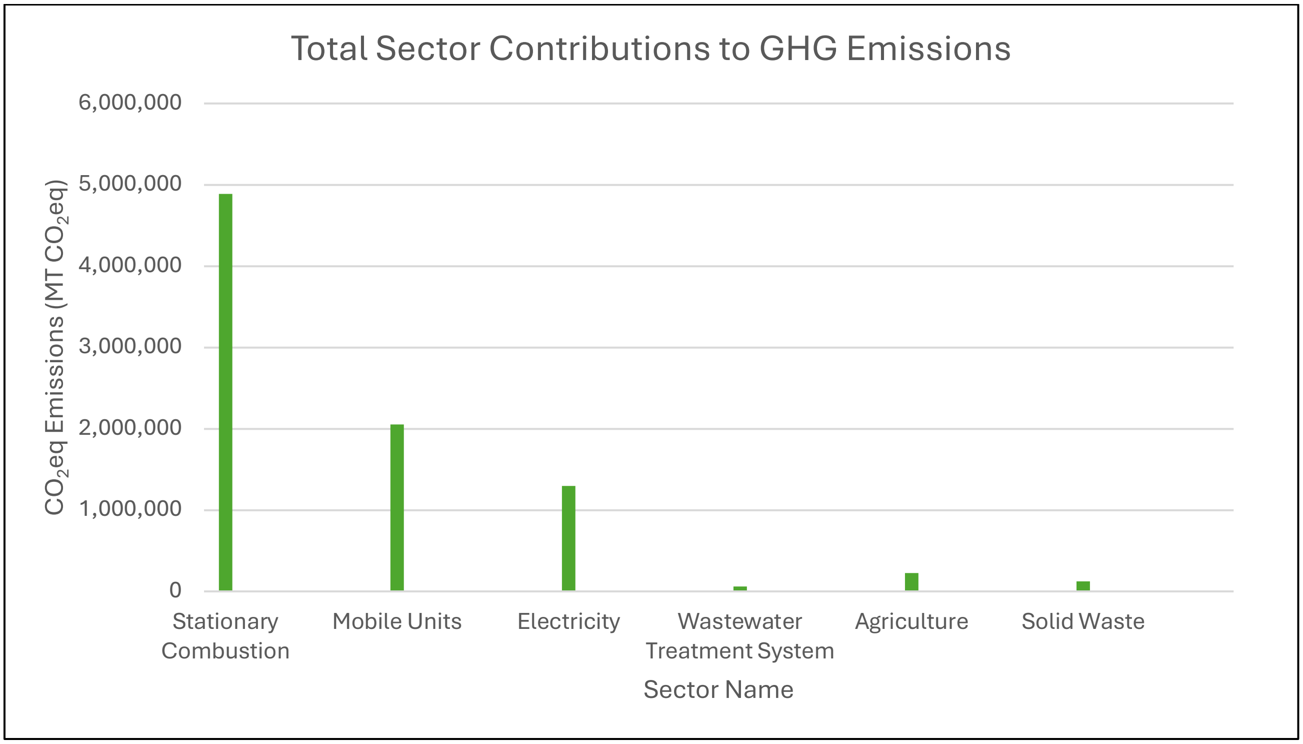
Table 3.1 below provides a high-level summary of the GHG emissions, organized by the emission source.

Table 3.1. CNO 2023 Base Year GHG Emissions

Category	Sector	Sectoral CO_2e Emissions (metric tons)	Total CO_2e Emissions (metric tons)
Stationary Combustion	Residential	184,460	**4,887,801**
	Commercial/Institutional	--	
	Industrial	770,507	
	Energy Generation	3,932,835	
Mobile Units	Sector Data Not Available		**2,051,042**
Electricity	Residential	579,769	**1,296,296**
	Commercial/Institutional	373,089	
	Industrial	343,438	
	Energy Generation	--	
Urban Forestry (Sequestration)	Residential	--	**-25,821**
	Commercial/Institutional	-25,821	
	Industrial	--	
	Energy Generation	--	
Wastewater Treatment	Residential	--	**58,798**
	Commercial/Institutional	58,798	
	Industrial	--	
	Energy Generation	--	
Agriculture	Residential	--	**229,269**
	Commercial/Institutional	229,269	
	Industrial	--	
	Energy Generation	--	
Solid Waste	Residential	--	**123,910**
	Commercial/Institutional	123,910	
	Industrial	--	
	Energy Generation	--	
Total Emissions			**8,647,116**

Currently, the largest contributors to GHG emissions are the stationary combustion (57%), mobile units (24%), and electricity use (15%) categories.

Figure 3.1. CNO – 2023 GHG Emissions by Source Category



3.2 GHG Priority Reduction Measures

CNO has selected three priority reduction measures (RM) discussed in more detail below.

3.2.1 RM #1 – Installation of Automatic Lighting Sensors in all CNO operated facilities.

Lighting use constitutes between 10% and 20% of the total electricity consumption in commercial buildings.[14] Implementing automatic sensors to existing fixtures is a straightforward and effective retrofit option to reduce electricity consumption. Lighting control systems that dim or turn off the light in unoccupied areas can lead to significant energy savings. Studies have shown that adding lighting

[14] U.S. Energy Information Administration. 2018 Commercial Buildings Energy Consumption Survey. Building Characteristics Flipbook, DC: U.S. Energy Information Administration (EIA).

controls can reduce energy use by 10% to 90% or more depending on the space in which the sensors are installed.[15]

CNO proposes to install automatic sensors for lighting fixtures in all CNO owned and/or operated government buildings. CNO will conduct an evaluation of the different types of spaces within the government buildings to determine which type of sensors are appropriate for a given type of space.

3.2.1.1 RM #1 – Quantification of GHG Reductions

The total reduction in electricity consumption (in kWh/year) resulting from the installation of automatic lighting sensors in all CNO buildings was calculated using the annual electricity consumption for all CNO buildings in base year 2023, the average electricity consumed for lighting purposes, and the average savings in electricity consumption from the implementation of the occupancy sensors. The annual electricity consumption for CNO buildings were obtained from the utility provider, the average electricity consumed for lighting purposes is obtained from the U.S. EIA 2023 Commercial Buildings Energy Consumption Survey (CBECS), and the percent savings in electricity consumption from the implementation of occupancy sensors is obtained from the U.S. Department of Energy's Better Buildings Division.

Once the reduced electricity consumption is calculated, the GHG emissions were calculated for CO_2, CH_4, and N_2O and the emission factors provided from the eGrid Power Profiler for subregion SPSO.[16]

Implementation began in 2024. Implementation includes the purchase and installation of sensors at CNO facilities. EPS will host biannual meetings to review RM status. RM #1 progress of electric usage will be tracked through Utility Authority billing, number of facilities with automatic sensors, and cost savings.

Priority RM #1 is expected to result in an **annual reduction of 304 metric tons of CO_2e**.

3.2.2 RM #2 – Reduction of Single-Use plastics in CNO Government Operations

Single-use plastics (SUP) are goods that are made primarily from fossil fuel–based chemicals (petrochemicals) and are meant to be disposed of right after a single use. Single-use plastics are most commonly used for packaging and service-ware, such as bags, bottles, wrappers, and straws. Since most single-use plastics are not recycled, they eventually end up in landfills and thereby contribute to GHG emissions from solid waste.

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[15] U.S. Department of Energy Fact Sheet on Wireless Sensors for Lighting Energy Savings. Wireless-Sensors-Guidance.pdf (energy.gov)

[16] eGrid Power Profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO.

Reduction or elimination of single-use plastics is a very effective way to reduce GHG emissions resulting from the entire life cycle of single-use plastics – i.e., raw materials extraction, production, transportation, and end-of-life management. This will eventually result in a reduction in GHG emissions associated with solid waste emission category.

CNO proposes to eliminate roughly 39 tons of single-use plastics from its operations.

3.2.2.1 RM #2 - Quantification of GHG Reductions

The estimated single-use plastics to be eliminated by RM#2 is calculated from the number of employees using single-use plastics provided by CNO and the average plastic use per capita in the U.S. The emissions reduction was then calculated by multiplying the estimated single-use plastics eliminated by the emission factors for source reduction of various plastic materials from the Documentation of GHG Emission Factors from the U.S. EPA's Waste Reduction Model (WARM).[17]

Implementation began in 2024 with the initial phase with sipable lids available in common areas. Future efforts will include reduction of single use containers, plasticware, straws and bags. EPS will host biannual meetings to review RM status. RM #2 progress will track cost savings from reduction in SUP purchases.

Priority RM# 2 is expected to result in an **annual reduction of 58 metric tons of CO_2e.**

3.2.3 RM #3 – Switch Traditional Lighting to Light-Emitting Diode (LED) in CNO Operated Buildings

LED is a highly energy-efficient lighting technology and uses at least 75% less energy compared to conventional lighting.[18] LED lighting offers several advantages over traditional lighting options, such as fluorescent or incandescent lighting, which can contribute to reducing GHG emissions. They require significantly less electricity to produce the same amount of light. They can last up to 25 times longer than incandescent bulbs and around 3-5 times longer than fluorescent lights. LED lighting converts a higher percentage of the energy into light. This lower heat generation reduces the need for cooling systems, especially in commercial buildings, which can further save energy and reduce GHG emissions.

CNO proposes to switch traditional lighting at all of its government buildings to LED lighting.

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[17] U.S. EPA Waste Reduction Model (WARM), Documentation for GHG Emission and Energy Factors, Management Practices Chapter, Dec 2023, EPA-530-R-23-018, Exhibit 1-1. Available here: https://www.epa.gov/system/files/documents/2024-01/warm_management_practices_v16_dec.pdf

[18] https://www.energy.gov/energysaver/led-lighting#:~:text=Residential%20LEDs%20%2D%2D%20especially%20ENERGY,times%20longer%2C%20than%20incandescent%20lighting.

3.2.3.1 RM #3 - Quantification of GHG Reductions

The total reduction in electricity consumption (in kWh/year) resulting from LED lighting installation was calculated using the percentage of energy savings for LED lighting, the average electricity consumed for lighting, and the annual electricity consumption in CNO properties in base year 2023. The typical energy savings for LED lighting is 75%, compared to incandescent lighting and approximately 17% of electricity consumed in commercial building is used for lighting.[19]

GHG emissions for CO_2, CH_4, and N_2O were calculated using the total reduction in electricity consumption and emission factors provided from the eGrid Power Profiler for subregion SPSO.[20] SO_2 and NO_x emissions were also calculated using emission factors from the U.S. EIA State Electricity Profile.[21]

Implementation is expected to begin in 2025. Implementation will include the purchase and installation of LED bulbs in CNO owned facilities. EPS will host biannual meetings to review RM status. RM #3 progress of electric usage will be tracked through Utility Authority billing, number of facilities with LED lighting, and cost savings.

Priority RM#3 is expected to result in an **annual reduction of 462 metric tons of CO_2e.**

3.3 Benefits Analysis

The primary co-benefit of the implementation of the priority reduction measures selected by CNO to reduce GHG emissions is the accompanying reduction in air pollution. Air pollutants are emitted into the atmosphere during the generation of electricity from traditional fossil fuels. Both RM#1 (automatic lighting sensors) and RM#3 (Switch to LED lighting) will reduce the consumption of electricity in buildings. This reduction in use of electricity will have a corresponding reduction in air pollution typically associated with electricity generation.

RM#2 (elimination of single-use plastics) will also have a beneficial impact on reduction in air pollution – from avoided emissions of air pollutants from raw material extraction and manufacturing processes during the production of the single-use plastics. Elimination of single-use plastics will also have beneficial impacts on the overall environment by reducing potential waste and harm to water bodies, flora, and fauna.

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[19] U.S. Department of Energy's Energy Saver resource. https://www.energy.gov/energysaver/led-lighting#:~:text=Residential%20LEDs%20%2D%2D%20especially%20ENERGY,times%20longer%2C%20than%20incandescent%20lighting.

[20] eGrid Power Profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO.

[21] U.S. Energy Information Administration (EIA). 2021 State Electricity Profile for Oklahoma. Available here: https://www.eia.gov/electricity/state/oklahoma/

SO_2 and NO_x emissions reductions were also calculated for RM#1 and RM#3 using emission factors from the U.S. EIA State Electricity Profile.[22] These are summarized in Table 3-2 and Table 3-3 below.

Table 3.2. Benefits Quantification – RM # 1

	Baseline – Year 2023, kg/yr	Reduction due to RM # 1, kg/yr
Sulfur dioxide (SO_2)	189	94
Nitrogen oxide (NO_X)	379	187

Table 3.3. Benefits Quantification – RM # 3

	Baseline – Year 2023, kg/yr	Reduction due to RM # 3, kg/yr
Sulfur dioxide (SO_2)	189	142
Nitrogen oxide (NO_X)	379	284

3.4 Review of Authority to Implement

The proposed priority reduction measures only include CNO owned and/or operated entities and operations, thus, CNO has full authority to implement the selected measures. CNO has the authority to receive federal funds and distribute those funds in accordance with the associated federal government grant program requirements.

3.5 Identification of other Funding Mechanisms

CNO has identified alternative general funding mechanisms for projects, in three general classes:

1. **Competitive grants**: Funding grants through rigorous applications processes, prioritizing projects that demonstrate superior merit and potential impact. Competitive grants can support clean energy infrastructure projects such as carbon capture and storage as well as deployment capabilities for renewable energy technology in the form of solar and wind energy generation.

2. **Formula grants:** Programs such as these distribute pre-determined funding allocations based on a set formula, ensuring consistent support for essential clean energy initiatives. Examples of these are Conservation Block Grant program and Tribal formula grant program.

[22] U.S. Energy Information Administration (EIA). 2021 State Electricity Profile for Oklahoma. Available here: https://www.eia.gov/electricity/state/oklahoma/

3. **Other funding opportunities:** Other funding opportunities for tribes can be found in the White House Inflation Reduction Act Tribal Guidebook[23] and the U.S. Department of Energy's Tribal Nations and Native Communities Resource Guide[24].

3.6 Workforce Planning Analysis

A strategic approach to developing a skilled workforce is essential. Emphasizing safety and environmental training in all aspects of the program ensures the workforce is adequately prepared to handle any hazards and comply with environmental regulations. This strategy includes specialized training programs that focus on technical skills such as environmental restoration techniques.

Targeted workforce development requires leveraging our existing partner base including local, tribal, state and federal agencies. CNO will serve as a training hub where on-site training and experience can be gained.

Collaborations with outside entities such as clean energy companies can potentially provide hands-on training and potential internships. This strategy may include developing apprentice type programs.

4.0 Next steps

The CNO presents this PCAP as a step towards enhancing climate resilience within the tribal territories of southeastern Oklahoma. The Priority Climate Action Plan (PCAP) outlined here has identified sources of greenhouse gas emissions but also proposes strategic, scalable solutions. The PCAP groundwork laid out will aid in the development of the Comprehensive Climate Action Plan. These future steps will focus on refining the strategies and expanding the scope to ensure a sustainable future.

[23] Guidebook to the Inflation Reduction Act's Clean Energy and Climate Investments in Indian Country. Available here: inflation-reduction-act_tribal-guidebook.pdf

[24] U. S. Department of Energy's Tribal Nations and Native Communities Resource Guide. Available here: Department of Energy's Tribal Nations and Native Communities Resource Guide

Appendix A – GHG Emissions Summary

Greenhouse Gas Emissions Summary - County Level

Emissions Category Name	Sector	Total CO_2e Emissions (metric tonnes)													
		Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc	Total CNO Boundary
Stationary Combustion	Residential	11,585	11,387	9,437	7,598	39,559	24,455	34,680	8,614	26,936	3,957	3,688	582	1,981	184,460
	Commercial/Institutional														-
	Industrial	0	0	0	51,455	0	309,642	68,086	0	32,576	179,288	129,460	0	0	770,507
	Energy Generation	0	968,893	0	0	871,594	0	2,092,347	0	0	0	0	0	0	3,932,835
	Total Emissions	**11,585**	**980,280**	**9,437**	**59,053**	**911,153**	**334,097**	**2,195,113**	**8,614**	**59,512**	**183,245**	**133,148**	**582**	**1,981**	**4,887,801**
Mobile Units	Residential														-
	Commercial/Institutional														-
	Industrial														-
	Energy Generation														-
	Total Emissions	**269,540**	**137,218**	**87,797**	**67,811**	**316,771**	**260,120**	**422,722**	**105,235**	**284,224**	**43,962**	**34,519**	**6,269**	**14,854**	**2,051,042**
Electricity	Residential	34,986	39,378	30,662	26,939	112,288	86,167	115,973	27,940	74,526	14,391	8,707	1,995	5,817	579,769
	Commercial/Institutional	18,598	27,265	15,881	13,783	71,133	52,909	88,981	17,679	45,944	9,647	5,341	843	5,084	373,089
	Industrial	8,928	8,458	27,259	19,473	66,063	76,993	50,421	6,790	43,985	4,960	17,949	982	11,177	343,438
	Energy Generation														-
	Total Emissions	**62,512**	**75,101**	**73,802**	**60,195**	**249,484**	**216,069**	**255,375**	**52,409**	**164,455**	**28,998**	**31,997**	**3,820**	**22,078**	**1,296,296**
Urban Forestry (Sequestration)	Residential														-
	Commercial/Institutional	-375	-1,951	-964	-1,472	-6,707	-6,150	-5,032	-536	-2,464	-98	-70	0	-2	-25,821
	Industrial														-
	Energy Generation														-
	Total Sequestration	**-375**	**-1,951**	**-964**	**-1,472**	**-6,707**	**-6,150**	**-5,032**	**-536**	**-2,464**	**-98**	**-70**	**0**	**-2**	**-25,821**
Wastewater Treatment System	Residential														-
	Commercial/Institutional														58,798
	Industrial														-
	Energy Generation														-
	Total Emissions	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**58,798**
Agriculture	Residential														-
	Commercial/Institutional														229,269
	Industrial														-
	Energy Generation														-
	Total Emissions	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**229,269**
Solid Waste	Residential														-
	Commercial/Institutional	0	0	0	0	0	96,588	18,782	5,933	2,607	0	0	0	0	123,910
	Industrial														-
	Energy Generation														-
	Total Emissions	**0**	**0**	**0**	**0**	**0**	**96,588**	**18,782**	**5,933**	**2,607**	**0**	**0**	**0**	**0**	**123,910**

Choctaw Nations of Oklahoma
Base Year 2023
Stationary Combustion

Methodology
Residential: Data is obtained from the United States (U.S.) Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS). Data is available for the State of Oklahoma for Year 2020. Data is scaled using population data to CNO boundary for Base Year 2023.
Commercial/Institutional: No publicly available data.
Industrial: Data is obtained from the U.S. Environmental Protection Agency (EPA) Facility Level GreenHouse gas Tool (FLIGHT). Data is organized per county based on the facility location for Year 2022. Data is scaled using population data to CNO boundary for Base Year 2023.
Energy Generation: Data is obtained from the U.S. Environmental Protection Agency (EPA) Facility Level GreenHouse gas Tool (FLIGHT). Data is organized per county based on the facility location for Year 2022. Data is scaled using population data to CNO boundary for Base Year 2023.

Use EPA FLIGHT for Industrial & Energy Generation + EIA RECS for Residential. No data available for Commercial/Institutional Sector.

Residential Stationary Combustion - Raw Data

Category	Data Year	Data	Geographic Boundary	Value	Unit of Measurement
Residential [1]	2020	Natural Gas Consumption	State of Oklahoma	5.32E+10	scf
	2020	Propane Consumption	State of Oklahoma	4.64E+07	gallons
Data Scaled to 2023 Base Year and CNO Boundary [2]					
Residential	2023	Natural Gas Consumption	CNO Boundary	3.10E+09	scf
	2023	Propane Consumption	State of Oklahoma	2.71E+06	gallons

1. Data obtained from the U.S. EIA RECS, "CE2.1.ST Annual household site fuel consumption in United States homes by state - totals and averages, 2020." Available at https://www.eia.gov/consumption/residential/data/2020/state/pdf/ce2.1.st.pdf
2. Data scaled by the Population in the Activity Data tab.

Residential Stationary Combustion - GHG and Criteria Emissions

Fuel Type	Pollutant Category	Pollutant	Emission Factor [1, 2, 3]	Emission Factor Units	Total Emissions [5] (metric tonnes)													Total CNO Emissions (metric tonnes)
					Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc	
Natural Gas	**Fuel Usage [4] (scf)**				194,876,267	191,535,531	158,745,335	127,806,631	665,410,213	411,353,277	583,340,807	144,899,393	453,078,936	66,559,805	62,038,407	9,788,759	33,326,860	**3,102,760,220**
	GHG	CO_2	5.31E+01	kg/MMBtu	10,609	10,427	8,642	6,958	36,225	22,394	31,757	7,888	24,665	3,623	3,377	533	1,814	**168,913**
	GHG	CH_4	1.00E-03	kg/MMBtu	0.1999	0.1965	0.1629	0.1311	0.6827	0.4220	0.5985	0.1487	0.4649	0.0683	0.0637	0.0100	0.0342	**3.1834**
	GHG	N_2O	1.00E-04	kg/MMBtu	0.0200	0.0197	0.0163	0.0131	0.0683	0.0422	0.0599	0.0149	0.0465	0.0068	0.0064	0.0010	0.0034	**0.3183**
	Criteria	NO_x	9.40E-05	lb/scf	8.3091	8.1666	6.7685	5.4494	28.3715	17.5392	24.8723	6.1782	19.3182	2.8380	2.6452	0.4174	1.4210	**132.2945**
	Criteria	CO	4.00E-05	lb/scf	3.5358	3.4752	2.8802	2.3189	12.0730	7.4635	10.5840	2.6290	8.2205	1.2076	1.1256	0.1776	0.6047	**56.2955**
	Criteria	PM (total)	7.60E-06	lb/scf	0.6718	0.6603	0.5472	0.4406	2.2939	1.4181	2.0110	0.4995	1.5619	0.2295	0.2139	0.0337	0.1149	**10.6962**
	Criteria	SO_2	6.00E-07	lb/scf	0.0530	0.0521	0.0432	0.0348	0.1811	0.1120	0.1588	0.0394	0.1233	0.0181	0.0169	0.0027	0.0091	**0.8444**
	Criteria	TOC	1.10E-05	lb/scf	0.9723	0.9557	0.7921	0.6377	3.3201	2.0525	2.9106	0.7230	2.2606	0.3321	0.3095	0.0488	0.1663	**15.4813**
	Criteria	VOC	5.50E-06	lb/scf	0.4862	0.4778	0.3960	0.3188	1.6600	1.0262	1.4553	0.3615	1.1303	0.1661	0.1548	0.0244	0.0831	**7.7406**
	Criteria	Lead	5.00E-10	lb/scf	4.42E-05	4.34E-05	3.60E-05	2.90E-05	1.51E-04	9.33E-05	1.32E-04	3.29E-05	1.03E-04	1.51E-05	1.41E-05	2.22E-06	7.56E-06	**7.04E-04**
Propane	**Fuel Usage [4] (gal)**				169,967	167,054	138,455	111,470	580,358	358,774	508,778	126,378	395,167	58,052	54,109	8,538	29,067	**2,706,167**
	GHG	CO_2	6.29E+01	kg/MMBtu	972	956	792	638	3,320	2,053	2,911	723	2,261	332	310	49	166	**15,482**
	GHG	CH_4	3.00E-03	kg/MMBtu	0.0464	0.0456	0.0378	0.0304	0.1584	0.0979	0.1389	0.0345	0.1079	0.0158	0.0148	0.0023	0.0079	**0.7388**
	GHG	N_2O	6.00E-04	kg/MMBtu	0.0093	0.0091	0.0076	0.0061	0.0317	0.0196	0.0278	0.0069	0.0216	0.0032	0.0030	0.0005	0.0016	**0.1478**
	Criteria	NO_x	1.30E-02	lb/gal	1.0022	0.9851	0.8164	0.6573	3.4222	2.1156	3.0001	0.7452	2.3302	0.3423	0.3191	0.0503	0.1714	**15.9575**
	Criteria	CO	7.50E-03	lb/gal	0.5782	0.5683	0.4710	0.3792	1.9743	1.2205	1.7308	0.4299	1.3443	0.1975	0.1841	0.0290	0.0989	**9.2062**
	Criteria	PM (total)	7.00E-04	lb/gal	0.0540	0.0530	0.0440	0.0354	0.1843	0.1139	0.1615	0.0401	0.1255	0.0184	0.0172	0.0027	0.0092	**0.8592**
	Criteria	SO_2	5.40E-02	lb/gal	4.1632	4.0918	3.3913	2.7304	14.2153	8.7878	12.4620	3.0955	9.6792	1.4219	1.3253	0.2091	0.7120	**66.2848**
	Criteria	TOC	1.00E-03	lb/gal	0.0771	0.0758	0.0628	0.0506	0.2632	0.1627	0.2308	0.0573	0.1792	0.0263	0.0245	0.0039	0.0132	**1.2275**

1. Natural gas' NO_x and CO emission factors per Table 1.4-1 of AP-42 Chapter 1.4 Natural Gas Combustion, for Residential Furnaces (uncontrolled). Other natural gas' criteria pollutants emissions factor per Table 1.4-2 of AP-42, Chapter 1.4, Natural Gas Combustion.

2. Propane's emission factors per Table 1.5-1 of AP-42 Chapter 1.5 Liquefied Petroleum Gas combustion, for Propane Commercial Boilers. For SO_2 emissions, a sulfur fuel content value of 0.54 gr/scf was assumed, as referenced by *A National Methodology and Emission Inventory for Residential Fuel Combustion* (see link here: https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf)

3. Natural gas and propane emission factors for CO_2 per Table C-1 to 40 CFR Part 98 Subpart C - Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel. Emission factors for CH_4 and N_2O per Table C-2 to 40 CFR Part 98 Subpart C - Default CH_4 and N_2O Emission Factors for Various Types of Fuel. High heating values listed below for emission calculations.

Natural Gas HHV (MMBtu/scf) = 1.03E-03 Propane HHV (MMBtu/gal) = 0.091

4. Fuel Usage for each county is scaled using the population data in the Activity Data tab.

5. Natural Gas Combustion Emissions (metric tonnes) = Fuel Usage (scf) * Natural Gas HHV (MMBtu/scf) * Emission Factor (kg/MMBtu). Converted to metric tonnes.
Natural Gas Combustion Emissions (metric tonnes) = Fuel Usage (scf) * Emission Factor (lb/scf). Converted to metric tonnes.
Propane Combustion Emissions (metric tonnes) = Fuel Usage (gal) * Natural Gas HHV (MMBtu/gal) * Emission Factor (kg/MMBtu). Converted to metric tonnes.
Propane Combustion Emissions (metric tonnes) = Fuel Usage (gal) * Emission Factor (lb/gal). Converted to metric tonnes.

Residential Stationary Combustion - GHG Emissions Summary

Pollutant Category	Pollutant	GWP [1]	CO_2e Emissions [2] (metric tonnes)													Total CNO Emissions (metric tonnes)
			Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc	
GHG	CO_2	1	11,581	11,383	9,434	7,595	39,545	24,447	34,668	8,611	26,926	3,956	3,687	582	1,981	**184,395**
GHG	CH_4	27.9	1.4945	1.4689	1.2174	0.9802	5.1031	3.1547	4.4737	1.1113	3.4747	0.5105	0.4758	0.0751	0.2556	**23.7955**
GHG	N_2O	273	2.5535	2.5097	2.0801	1.6747	8.7190	5.3900	7.6436	1.8986	5.9368	0.8721	0.8129	0.1283	0.4367	**40.6559**

1. GWPs per IPCC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
2. CO2e Emissions (metric tonnes) = Emissions (metric tonnes) * GWP.

Industrial and Energy Generation Stationary Combustion - Emissions

Category	Data Year	Pollutant Category	Pollutant	Total CO_2e Emissions (metric tonnes)													Total CNO GHG Emissions (metric tonnes)
				Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc	
Industrial [1]	2022	GHG	CO_2e	0	0	0	51,709	0	315,439	69,481	0	30,619	181,745	131,252	0	0	**780,245**
Energy Generation [1]	2022	GHG	CO_2e	0	977,173	0	0	857,342	0	2,135,225	0	0	0	0	0	0	**3,969,740**
Data Scaled to 2023 Base Year and CNO Boundary [2]																	
Industrial	2023	GHG	CO_2e	0	0	0	51,455	0	309,642	68,086	0	32,576	179,288	129,460	0	0	**770,507**
Energy Generation	2023	GHG	CO_2e	0	968,893	0	0	871,594	0	2,092,347	0	0	0	0	0	0	**3,932,835**

1. Data obtained from the U.S. EPA FLIGHT. Available at: https://ghgdata.epa.gov/ghgp/main.do. FLIGHT data is per facility and is sorted by County. County emissions is obtained from adding all the facilities within the CNO boundary.
2. Data scaled by the Population in the Activity Data tab.

Total Stationary Combustion GHG Emissions Summary

Category	Data Year	Pollutant Category	Pollutant	CO_2e Emissions [2] (metric tonnes)													Total CNO Emissions (metric tonnes)
				Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc	
Residential	2023	GHG	CO_2e	11,585	11,387	9,437	7,598	39,559	24,455	34,680	8,614	26,936	3,957	3,688	582	1,981	**184,460**
Industrial	2023	GHG	CO_2e	0	0	0	51,455	0	309,642	68,086	0	32,576	179,288	129,460	0	0	**770,507**
Energy Generation	2023	GHG	CO_2e	0	968,893	0	0	871,594	0	2,092,347	0	0	0	0	0	0	**3,932,835**
			Total CO2e Emissions	**11,585**	**980,280**	**9,437**	**59,053**	**911,153**	**334,097**	**2,195,113**	**8,614**	**59,512**	**183,245**	**133,148**	**582**	**1,981**	**4,887,801**

Choctaw Nations of Oklahoma
Base Year 2023
Mobile Units Combustion

Methodology
Data is obtained from the U.S. EPA's National Emissions Inventory (NEI) tool, "Mobile Sources", 2020 county-level data.

National Emissions Inventory

Mobile Sources Criteria, Toxics, and HAP Emissions

		2020 Total County Level Emissions [1] (metric tonnes)												
Pollutant Category	**Pollutants**	**Atoka**	**Choctaw**	**Haskell**	**Latimer**	**Le Flore**	**McCurtain**	**Pittsburg**	**Pushmataha**	**Bryan**	**Coal**	**Hughes**	**Johnston**	**Pontotoc**
GHG	Carbon Dioxide	261,433	135,660	85,070	66,773	305,130	259,669	422,979	104,740	385,443	46,412	99,141	87,671	226,091
GHG	Methane	13.4474	11.9991	12.4943	5.5673	25.3410	26.0232	36.9590	9.4354	31.0118	3.2036	7.8452	7.8131	19.0622
GHG	Nitrous Oxide	2.3557	1.9428	1.3479	1.0938	5.7320	3.7795	5.7544	1.2746	5.1794	0.5952	1.5583	1.3372	3.6859
Criteria	Nitrogen Oxides	697.0828	337.6875	233.2219	164.6805	843.2135	626.1338	1,084.3596	232.1185	840.2191	103.6744	285.1464	240.0351	450.8520
Criteria	Carbon Monoxide	2,324.8685	1,793.7909	1,611.5087	843.7592	3,673.6581	3,670.9480	5,399.8382	1,414.1363	4,363.5636	512.7549	1,176.5279	1,150.7782	2,639.1915
Criteria	Volatile Organic Compounds	158.2963	184.2465	218.9365	78.5437	336.3518	381.9654	519.9283	152.0041	385.1869	42.5409	102.7332	110.9777	195.7051
Criteria	Ammonia	12.1088	6.3369	3.6905	3.0379	14.3494	11.6648	19.7176	4.8306	17.6231	2.2134	4.4713	4.2070	10.1814
Criteria	PM10 Primary (Filt + Cond)	5,646.1744	2,266.8005	1,383.7767	1,529.2010	5,185.0351	5,210.4260	6,289.7551	2,482.0576	4,704.9290	871.2730	1,495.2905	1,799.3675	3,055.5343
Criteria	PM2.5 Primary (Filt + Cond)	624.4014	254.8656	154.6410	168.8181	583.0934	579.4440	709.3148	272.4447	533.9246	96.5748	168.9178	196.8232	345.3631
Criteria	Sulfur Dioxide	1.3831	0.7209	0.4645	0.3412	1.7423	1.3506	2.2973	0.5323	2.1340	0.2338	0.5414	0.4857	1.2258
HAP	Formaldehyde	4.6217	2.9848	2.5056	1.5091	7.5324	5.9931	8.6762	1.9195	6.7026	0.8946	2.5612	2.0771	3.6099
HAP	Acetaldehyde	2.1852	1.5616	1.3645	0.7875	3.8120	3.1213	4.5355	1.0745	3.5060	0.4618	1.2410	1.0389	2.0016
HAP	Xylenes (Mixed Isomers)	8.3145	10.3394	12.5896	4.3577	18.4140	21.8549	29.1865	8.6976	21.6738	2.3259	5.6118	6.1535	10.9453
HAP	Toluene	13.9611	17.5565	20.7818	7.5374	32.4365	36.2395	49.2488	14.4078	37.1890	4.0418	9.6180	10.6006	19.3112
HAP	Naphthalene	0.2999	0.2759	0.3093	0.1184	0.5150	0.5755	0.7978	0.2285	0.5666	0.0680	0.1658	0.1648	0.2811
HAP	Acrolein	0.3438	0.2197	0.1743	0.1147	0.5704	0.4368	0.6208	0.1358	0.4951	0.0725	0.1979	0.1512	0.2707
HAP	Benzene	3.1621	4.0721	5.2156	1.6619	6.9159	8.4974	11.4667	3.3863	8.2232	0.8815	2.1808	2.4261	4.1144
HAP	Ethylbenzene	2.2108	2.7839	3.4117	1.1646	4.9237	5.9190	7.8469	2.3534	5.8230	0.6213	1.5009	1.6505	2.9004
HAP	Propionaldehyde	0.5037	0.2499	0.1578	0.1256	0.7558	0.4675	0.7796	0.1222	0.6055	0.0626	0.2563	0.1945	0.2978
HAP	Polycyclic Organic Matter	0.1472	0.1226	0.1259	0.0552	0.2468	0.2561	0.3523	0.0966	0.2598	0.0327	0.0823	0.0751	0.1323
HAP	2,2,4-Trimethylpentane	5.4541	8.9611	13.2667	3.2077	12.1607	19.9231	24.8610	8.3097	17.0658	1.5616	3.9460	5.0201	6.3783
HAP	1,3-Butadiene	0.4375	0.5941	0.7872	0.2441	0.9938	1.2699	1.6905	0.5099	1.1603	0.1240	0.3102	0.3495	0.5960
HAP	Hexane	3.0320	3.9266	4.6387	1.6960	7.3949	7.8118	10.9223	3.1689	8.2509	0.9065	2.1246	2.3816	4.3926
HAP	Styrene	0.1642	0.2671	0.4073	0.0952	0.3394	0.5877	0.7557	0.2466	0.4830	0.0455	0.1171	0.1504	0.1944
HAP	Manganese Compounds	0.0133	0.0041	0.0004	0.0014	0.0179	0.0064	0.0181	0.0004	0.0150	0.0000	0.0052	0.0039	0.0063
HAP	Arsenic Compounds	0.0061	0.0016	0.0000	0.0005	0.0076	0.0022	0.0074	0.0000	0.0058	0.0000	0.0022	0.0017	0.0021
HAP	Nickel Compounds	0.0216	0.0052	0.0000	0.0019	0.0259	0.0070	0.0241	0.0003	0.0183	0.0000	0.0083	0.0062	0.0066
		2023 CNO Emissions [2] (metric tonnes)												
Pollutant Category	**Pollutants**	**Atoka**	**Choctaw**	**Haskell**	**Latimer**	**Le Flore**	**McCurtain**	**Pittsburg**	**Pushmataha**	**Bryan**	**Coal**	**Hughes**	**Johnston**	**Pontotoc**
GHG	Carbon Dioxide	268,494	136,348	87,064	67,353	314,430	258,371	420,138	104,624	282,554	43,724	34,296	6,227	14,754
GHG	Methane	13.8106	12.0599	12.7872	5.6156	26.1135	25.8932	36.7108	9.4250	22.7336	3.0180	2.7139	0.5549	1.2439
GHG	Nitrous Oxide	2.4193	1.9526	1.3795	1.1033	5.9067	3.7606	5.7158	1.2732	3.7968	0.5607	0.5391	0.0950	0.2405
Criteria	Nitrogen Oxides	715.9109	339.3992	238.6888	166.1104	868.9152	623.0045	1,077.0766	231.8609	615.9333	97.6697	98.6397	17.0492	29.4212
Criteria	Carbon Monoxide	2,387.6628	1,802.8837	1,649.2838	851.0854	3,785.6334	3,652.6016	5,363.5704	1,412.5667	3,198.7658	483.0568	406.9922	81.7375	172.2252
Criteria	Volatile Organic Compounds	162.5719	185.1805	224.0685	79.2256	346.6040	380.0565	516.4363	151.8354	282.3662	40.0770	35.5381	7.8825	12.7711
Criteria	Ammonia	12.4358	6.3690	3.7770	3.0643	14.7868	11.6065	19.5851	4.8253	12.9189	2.0852	1.5467	0.2988	0.6644
Criteria	PM10 Primary (Filt + Cond)	5,798.6767	2,278.2909	1,416.2136	1,542.4786	5,343.0780	5,184.3857	6,247.5102	2,479.3028	3,449.0080	820.8100	517.2607	127.8055	199.3944
Criteria	PM2.5 Primary (Filt + Cond)	641.2664	256.1576	158.2660	170.2839	600.8664	576.5481	704.5507	272.1424	391.4002	90.9813	58.4331	13.9800	22.5373
Criteria	Sulfur Dioxide	1.4204	0.7246	0.4754	0.3442	1.7955	1.3438	2.2819	0.5317	1.5643	0.2203	0.1873	0.0345	0.0800
HAP	Formaldehyde	4.7466	2.9999	2.5644	1.5222	7.7620	5.9631	8.6179	1.9174	4.9134	0.8428	0.8860	0.1475	0.2356
HAP	Acetaldehyde	2.2442	1.5695	1.3964	0.7943	3.9282	3.1057	4.5051	1.0733	2.5701	0.4351	0.4293	0.0738	0.1306
HAP	Xylenes (Mixed Isomers)	8.5391	10.3918	12.8847	4.3955	18.9752	21.7456	28.9905	8.6879	15.8883	2.1912	1.9413	0.4371	0.7143
HAP	Toluene	14.3382	17.6455	21.2689	7.6028	33.4252	36.0584	48.9180	14.3918	27.2619	3.8077	3.3271	0.7529	1.2602
HAP	Naphthalene	0.3080	0.2773	0.3166	0.1194	0.5307	0.5726	0.7924	0.2283	0.4153	0.0641	0.0574	0.0117	0.0183
HAP	Acrolein	0.3531	0.2208	0.1784	0.1157	0.5878	0.4346	0.6166	0.1357	0.3629	0.0683	0.0685	0.0107	0.0177
HAP	Benzene	3.2475	4.0927	5.3378	1.6763	7.1267	8.4549	11.3897	3.3825	6.0281	0.8304	0.7544	0.1723	0.2685
HAP	Ethylbenzene	2.2706	2.7981	3.4916	1.1747	5.0737	5.8894	7.7942	2.3508	4.2686	0.5853	0.5192	0.1172	0.1893
HAP	Propionaldehyde	0.5173	0.2512	0.1615	0.1267	0.7789	0.4652	0.7743	0.1221	0.4439	0.0590	0.0887	0.0138	0.0194
HAP	Polycyclic Organic Matter	0.1512	0.1232	0.1289	0.0557	0.2543	0.2549	0.3499	0.0964	0.1904	0.0309	0.0285	0.0053	0.0086
HAP	2,2,4-Trimethylpentane	5.6015	9.0065	13.5777	3.2356	12.5314	19.8235	24.6940	8.3005	12.5103	1.4712	1.3650	0.3566	0.4162
HAP	1,3-Butadiene	0.4493	0.5971	0.8057	0.2462	1.0241	1.2636	1.6792	0.5093	0.8506	0.1168	0.1073	0.0248	0.0389
HAP	Hexane	3.1138	3.9465	4.7474	1.7107	7.6203	7.7728	10.8490	3.1654	6.0484	0.8540	0.7350	0.1692	0.2867
HAP	Styrene	0.1686	0.2685	0.4169	0.0960	0.3498	0.5848	0.7506	0.2464	0.3541	0.0429	0.0405	0.0107	0.0127
HAP	Manganese Compounds	0.0136	0.0041	0.0004	0.0014	0.0185	0.0064	0.0180	0.0004	0.0110	0.0000	0.0018	0.0003	0.0004
HAP	Arsenic Compounds	0.0063	0.0016	0.0000	0.0005	0.0078	0.0022	0.0073	0.0000	0.0042	0.0000	0.0008	0.0001	0.0001
HAP	Nickel Compounds	0.0222	0.0052	0.0000	0.0019	0.0267	0.0070	0.0239	0.0003	0.0134	0.0000	0.0029	0.0004	0.0004

1. All raw data is obtained from the U.S. EPA's National Emissions Inventory (NEI) tool, "Mobile Sources", 2020 county-level data.
2. Data scaled to CNO boundaries using population data.

GHG Emissions Summary

Pollutant	GWP [1]	CO₂e Emissions [2] (metric tonnes)													Total CNO Emissions (metric tonnes)
		Atoka	**Choctaw**	**Haskell**	**Latimer**	**Le Flore**	**McCurtain**	**Pittsburg**	**Pushmataha**	**Bryan**	**Coal**	**Hughes**	**Johnston**	**Pontotoc**	
CO_2	1	268,494	136,348	87,064	67,353	314,430	258,371	420,138	104,624	282,554	43,724	34,296	6,227	14,754	**2,038,377**
CH_4	27.9	385.3161	336.4715	356.7628	156.6750	728.5653	722.4192	1,024.2308	262.9562	634.2673	84.2029	75.7172	15.4830	34.7058	**4,817.7730**
N_2O	273	660.4711	533.0677	376.5955	301.1988	1,612.5315	1,026.6473	1,560.4131	347.5770	1,036.5273	153.0788	147.1660	25.9289	65.6646	**7,846.8674**
Total CO_2e Emissions		**269,540**	**137,218**	**87,797**	**67,811**	**316,771**	**260,120**	**422,722**	**105,235**	**284,224**	**43,962**	**34,519**	**6,269**	**14,854**	**2,051,042**

1. GWPs per IPPC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
2. CO2e Emissions (metric tonnes) = Emissions (metric tonnes) * GWP.

GHG Emissions Summary, Sorted by Mobile Source Category

Pollutants	GWP [1]	2020 Emissions, Sorted by Mobile Source Category [2] (tonnes)													
		Highway Vehicles						Off-highway Vehicle							
		Compressed Natural Gas (CNG)	Diesel	Electricity	Ethanol (E-85)	Gasoline	Total	CNG	Diesel	Gasoline	LPG	Total	Pleasure Craft	Railroad Equipment	Marine Vessels, Commercial
Carbon Dioxide	1	1,939	1,000,837	0	2,649	1,406,221	2,411,646	1,177	111,172	24,867	10,752	147,969	71,955	108,579	431
Methane	27.9	16.6888	21.5987	0.0000	0.2672	101.9966	140.5515	7.1414	2.1722	18.6032	0.6257	28.5425	54.0605	8.5543	0.0000
Nitrogen Oxides	273	0.9886	2,744.6795	0.0000	0.7993	1,506.0517	4,252.5191	3.1368	558.7986	51.5664	20.8932	634.3949	513.5461	1,360.1976	5.7977
Total CO_2e Emissions [4]		2,674	1,750,737	0	2,874	1,820,219	3,576,505	2,232	263,785	39,464	16,474	321,955	213,661	480,152	2,014

Pollutants	GWP [1]	2023 CNO Emissions, Sorted by Mobile Source Category [3] (tonnes)													
		Highway Vehicles						Off-highway Vehicle							
		Compressed Natural Gas	Diesel	Electricity	Ethanol (E-85)	Gasoline	Total	CNG	Diesel	Gasoline	LPG	Total	Pleasure Craft	Railroad Equipment	Marine Vessels, Commercial
Carbon Dioxide	1	113	58,371	0	154	82,014	140,653	69	6,484	1,450	627	8,630	4,197	6,333	25
Methane	27.9	0.9733	1.2597	0	0.0156	5.9487	8.1973	0.4165	0.1267	1.0850	0.0365	1.6647	3.1529	0.4989	0
Nitrogen Oxides	273	0.0577	160.0767	0	0.0466	87.8368	248.0178	0.1829	32.5906	3.0075	1.2185	36.9995	29.9513	79.3302	0.3381
Total CO_2e Emissions [4]		156	102,107	0	168	106,160	208,591	130	15,385	2,302	961	18,777	12,461	28,004	117

1. GWPs per IPPC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
2. All raw data is obtained from the U.S. EPA's National Emissions Inventory (NEI) tool, "Mobile Sources", 2020 state-level data.
3. Data scaled by the Population in the Activity Data tab.
4. CO2e Emissions (metric tonnes) = Emissions (metric tonnes) * GWP.

Choctaw Nations of Oklahoma
Base Year 2023
Electricity

Methodology
Data is obtained from the U.S. EPA's National Emissions Inventory (NEI) tool, "Mobile Sources", 2020 county-level data.

National Emissions Inventory

Activity Data

CNO County	2023 Total County Electricity Consumption [1] (MMBtu)			2023 CNO Electricity Consumption (MMBtu) [2]		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Atoka	269,892	143,472	68,870	269,892	143,472	68,870
Choctaw	303,774	210,333	65,245	303,774	210,333	65,245
Haskell	236,538	122,509	210,284	236,538	122,509	210,284
Latimer	207,818	106,323	150,223	207,818	106,323	150,223
Le Flore	866,218	548,743	509,629	866,218	548,743	509,629
McCurtain	664,712	408,158	593,944	664,712	408,158	593,944
Pittsburg	894,645	686,426	388,962	894,645	686,426	388,962
Pushmataha	215,537	136,382	52,379	215,537	136,382	52,379
Bryan	833,636	513,924	492,006	574,916	354,427	339,311
Coal	117,842	78,993	40,616	111,017	74,418	38,264
Hughes	195,170	119,713	402,338	67,168	41,199	138,465
Johnston	215,489	91,057	106,069	15,390	6,503	7,575
Pontotoc	693,656	606,175	1,332,752	44,876	39,216	86,221
			Total CNO Electricity Consumption (MMBtu)	**4,472,499**	**2,878,109**	**2,649,374**
			Total CNO Electricity Consumption (MWh)	**1,310,760**	**843,490**	**776,455**

1. 2023 Total County Electricity Consumption obtained from the National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE). https://maps.nrel.gov/slope/data-viewer?filters=%5B%5D&layer=energy-consumption.net-electricity-and-natural-gas-consumption&year=2020&res=state.
2. Data scaled to CNO boundaries using population data.

Emission Calculations

Category	Pollutant Category	Pollutant	Emission Factor [1] (lb/MWh)	Total Emissions [2] (metric tonnes)												
				Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc
Residential	**Electricity Consumption (MWh)**			79,097	89,028	69,322	60,905	253,863	194,808	262,194	63,168	168,491	32,536	19,685	4,510	13,152
	GHG	CO_2	9.70E+02	34,816	39,187	30,513	26,808	111,742	85,748	115,409	27,804	74,164	14,321	8,665	1,985	5,789
	GHG	CH_4	7.20E-02	2.5832	2.9075	2.2640	1.9891	8.2908	6.3622	8.5629	2.0630	5.5027	1.0626	0.6429	0.1473	0.4295
	GHG	N_2O	1.00E-02	0.3588	0.4038	0.3144	0.2763	1.1515	0.8836	1.1893	0.2865	0.7643	0.1476	0.0893	0.0205	0.0597
Commercial/ Institutional	**Electricity Consumption (MWh)**			42,047	61,642	35,904	31,160	160,821	119,619	201,172	39,970	103,872	21,810	12,074	1,906	11,493
	GHG	CO_2	9.70E+02	18,508	27,133	15,804	13,716	70,788	52,652	88,549	17,593	45,721	9,600	5,315	839	5,059
	GHG	CH_4	7.20E-02	1.3732	2.0132	1.1726	1.0177	5.2522	3.9066	6.5700	1.3054	3.3923	0.7123	0.3943	0.0622	0.3753
	GHG	N_2O	1.00E-02	0.1907	0.2796	0.1629	0.1413	0.7295	0.5426	0.9125	0.1813	0.4712	0.0989	0.0548	0.0086	0.0521
Industrial	**Electricity Consumption (MWh)**			20,184	19,122	61,628	44,026	149,358	174,068	113,994	15,351	99,442	11,214	40,580	2,220	25,269
	GHG	CO_2	9.70E+02	8,884	8,417	27,127	19,379	65,742	76,619	50,176	6,757	43,771	4,936	17,862	977	11,123
	GHG	CH_4	7.20E-02	0.6592	0.6245	2.0127	1.4378	4.8778	5.6848	3.7229	0.5013	3.2477	0.3662	1.3253	0.0725	0.8253
	GHG	N_2O	1.00E-02	0.0916	0.0867	0.2795	0.1997	0.6775	0.7896	0.5171	0.0696	0.4511	0.0509	0.1841	0.0101	0.1146

1. Emission Factor is provided from eGrid Power Profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO.
2. Total Emissions = Electricity Consumption (MWh) * Emission Factor (lb/MWh). Converted to metric tonnes.

Emission Calculations - GHG Summary

Category	Pollutant Category	Pollutant	GWP [1]	Total CO₂e Emissions [2] (metric tonnes)												
				Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc
Residential	GHG	CO_2	1	34,816	39,187	30,513	26,808	111,742	85,748	115,409	27,804	74,164	14,321	8,665	1,985	5,789
	GHG	CH_4	28	72.0717	81.1198	63.1650	55.4955	231.3143	177.5043	238.9054	57.5569	153.5252	29.6459	17.9364	4.1096	11.9835
	GHG	N_2O	273	97.9469	110.2434	85.8425	75.4196	314.3608	241.2319	324.6772	78.2209	208.6439	40.2894	24.3759	5.5851	16.2859
	Total CO_2e Emissions			**34,986**	**39,378**	**30,662**	**26,939**	**112,288**	**86,167**	**115,973**	**27,940**	**74,526**	**14,391**	**8,707**	**1,995**	**5,817**
Commercial/ Institutional	GHG	CO_2	1	18,508	27,133	15,804	13,716	70,788	52,652	88,549	17,593	45,721	9,600	5,315	839	5,059
	GHG	CH_4	28	38.3126	56.1671	32.7148	28.3925	146.5359	108.9942	183.3029	36.4194	94.6460	19.8724	11.0019	1.7366	10.4722
	GHG	N_2O	273	52.0676	76.3322	44.4601	38.5859	199.1453	148.1254	249.1124	49.4947	128.6258	27.0070	14.9517	2.3600	14.2320
	Total CO_2e Emissions			**18,598**	**27,265**	**15,881**	**13,783**	**71,133**	**52,909**	**88,981**	**17,679**	**45,944**	**9,647**	**5,341**	**843**	**5,084**
Industrial	GHG	CO_2	1	8,884	8,417	27,127	19,379	65,742	76,619	50,176	6,757	43,771	4,936	17,862	977	11,123
	GHG	CH_4	28	18.3911	17.4231	56.1542	40.1155	136.0911	158.6065	103.8682	13.9873	90.6095	10.2179	36.9755	2.0229	23.0245
	GHG	N_2O	273	24.9939	23.6784	76.3147	54.5178	184.9506	215.5495	141.1590	19.0090	123.1402	13.8863	50.2504	2.7491	31.2908
	Total CO_2e Emissions			**8,928**	**8,458**	**27,259**	**19,473**	**66,063**	**76,993**	**50,421**	**6,790**	**43,985**	**4,960**	**17,949**	**982**	**11,177**

1. GWPs per IPPC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
2. CO2eq Emissions (metric tonnes) = Emissions (metric tonnes) * GWP.

Choctaw Nations of Oklahoma
Base Year 2023
Urban Forestry

Methodology
Data is obtained from the U.S. Forest Service Research Data Archive, 2020 Total Urban Area and Percent Urban Area with Tree Cover.

U.S. Forest Service Research Data Archive

Activity Data

County	2020 Total Urban Area (km^2) [1]	2020 % Urban Area with Tree Cover [2]
Atoka County	1.9311	21.5500%
Choctaw County	10.0345	21.5500%
Haskell County	7.2018	14.8400%
Latimer County	7.6532	21.3200%
Le Flore County	28.9311	25.7000%
McCurtain County	24.1257	28.2600%
Pittsburg County	34.4339	16.2000%
Pushmataha County	2.7570	21.5500%
Bryan County	22.3363	18.0143%
Coal County	0.8824	14.1382%
Hughes County	3.4029	6.7588%
Johnston County	0.0909	1.1700%
Pontotoc County	2.3014	1.6998%

1. Total Urban Area obtained from the U.S. Forest Service Research Data Archive, *Urban Land Cover dataset*. Data accessible here: https://www.fs.usda.gov/rds/archive/catalog/RDS-2021-0075
2. Percent Urban Tree Cover obtained from the U.S. Forest Service Research Data Archive, *Urban Tree Cover dataset*. Data accessible here: https://www.fs.usda.gov/rds/archive/catalog/RDS-2021-0075

Emission Calculations

Parameter	Parameter Units	County-Level Data												
		Atoka	Choctaw	Haskell	Latimer	Le Flore	McCurtain	Pittsburg	Pushmataha	Bryan	Coal	Hughes	Johnston	Pontotoc
2023 Total Urban Area	km^2	1.9311	10.0345	7.2018	7.6532	28.9311	24.1257	34.4339	2.7570	15.1667	0.7701	1.1506	0.0064	0.1470
2023 Urban Area with Tree Cover	%	21.55%	21.55%	14.84%	21.32%	25.70%	28.26%	16.20%	21.55%	18.01%	14.14%	6.76%	1.17%	1.70%
CO_2e Emissions/Sequestration [1]	metric tonnes CO_2e	375	1,951	964	1,472	6,707	6,150	5,032	536	2,464	98	70	0	2

1. As referenced by the Tribal Greenhouse Gas Inventory Tool (TGIT), the Carbon Sequestration Factor for Oklahoma from the *EPA State Inventory Tools, Land-Use Change and Forestry module*. Modules can be downloaded here: https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool

CO2e Sequestration (metric tonnes) = Total Urban Area (km2) * Urban Area with Tree Cover (%) * (2.46 metric ton C/hectare/yr) * 100 hectare/km2) * (CO_2 Molecular Weight (44 g/mol) / C Molecular Weight (12 g/mol)

2.46 metric ton C/hectare/year (Oklahoma Carbon Sequestration Factor)

Choctaw Nations of Oklahoma
Base Year 2023
Wastewater Treatment Systems

Methodology
Data is obtained from the U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks. Data is available on a country-wide basis for Year 2022. Data is scaled using population data to CNO Boundary for Base Year 2023.

EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks.

EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks - Raw Data

Activity [1]	2022 Nationwide Emissions (MMT CO_2e)	Data Scaled to 2023 Base Year and CNO Boundary [4] (metric tonnes)
CH_4	**21**	**14,321**
Domestic Treatment	12	7,987
Domestic Effluent	2	1,377
Industrial Treatment [2]	7	4,613
Industrial Effluent [2]	1	344
N_2O	**22**	**15,078**
Domestic Treatment	17	11,705
Domestic Effluent	4	3,029
Industrial Treatment [3]	0	275
Industrial Effluent [3]	0	69
Total	**43**	**58,798**

1. Data obtained from Table 7-7 of Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. See report here: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.
2. Industrial activity for CH_4 includes the pulp and paper manufacturing, meat and poultry processing, fruit and vegetable processing, starch-based ethanol production, petroleum refining, and breweries industries.
3 Industrial activity for N_2O includes the pulp and paper manufacturing, meat and poultry processing, starch-based ethanol production, and petroleum refining.
4. Data scaled by Population Data below.

Methodology
Data is obtained from the 2017 Commercial Fertilizer Purchased (Nitrogen) statewide value from EPA and scale to CNO population acreage.

EPA 2017 Commercial Fertilizer Purchased (Nitrogen) - Oklahoma

Activity Data

Data	Data Year	Geographic Boundary	Value	Unit of Measurement
Fertilizer Purchased [1]	2017	State of Oklahoma	237,380	1000 kg of N
Data Scaled to CNO Boundary [2]				
Fertilizer Purchased	2017	CNO Boundary	36,742	1000 kg of N

1. Fertilizer Purchased value obtained from the Nutrient Pollution - Commercial Fertilizer Purchased, Fertilizer nitrogen data table. Data table provides amounts of fertilizer nitrogen (N) purchased by states in individual years; 2017 data utlized for calculation of N_2O emissions. Data table accessible here: https://www.epa.gov/nutrientpollution/commercial-fertilizer-purchased#table1
2. CNO Boundary area is obtained from "Activity Data - State of Oklahoma" Table.

N_2O Emissions from Fertilizer Application

Pollutant	Pollutant Emissions [1] (metric tonnes)	GWP [2]	Total CO_2e Emissions [3] (metric tonnes CO_2e)
N_2O	839.8128	273	229,269

1. For conservative emission estimation purposes, it is assumed all fertilizer applied is synthetic fertilizer. Fertilizer emissions are determined using the emission factors and calculation equation in the table below, as provided in the Tribal Greenhouse Gas Inventory Tool (TGIT).

Emission Factors and Calculation Basis for N_2O

Fertilizer Type	*Percent N Content*	*Percent N lost to Volatilization*	*Percent N Leach and Runoff*	*Percent from Applied N*	*Percent from Volatized N*	*Percent from Leached and Runoff N*	*N_2O Molecular Weight/N_2O-N Molecular Weight:*
Synthetic	1	0.1	0.3	0.0125	0.01	0.025	1.57
Organic	0.037	0.2	0.3	0.0125	0.01	0.025	
Manure	0.005	0.2	0.3	0.0125	0.01	0.025	

Sources: Unless otherwise noted, all fertilizer emission factors are IPCC default values from the Revised 1996 Guidelines for National GHG Inventories.
Eq. 11.1. Direct N2O Emissions from Managed Soils (IPCC 1996) = ((Fertilizer Consumption)*(Percent N Content)*(1-Percent N lost to Volatilization)*(Percent from Applied N)+(Fertilizer Consumption)*(Percent N Content)*(Percent N lost to Volatilization)*(Percent from Volatized N)+(Fertilizer Consumption)*(Percent N content)*(1-Percent N lost to Volatilization)*(Percent N Leach and Runoff)*(Percent from Leached and Runoff))*N2O/N2O-N*(metric tonnes*1.102 short tonnes)

2. GWPs per IPCC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
3. CO2eq Emissions (metric tonnes) = Emissions (metric tonnes) * GWP.

Choctaw Nations of Oklahoma
Base Year 2023
Solid Waste

Methodology
Data is obtained from the annual tonnage reports submitted to Oklahoma Department of Environmental Quality and is used as inputs into the California Air Resources Board's (CARB) Landfill Tool to calculate emissions.

OKDEQ Annual Tonnage Reports & CARB Tool

Activity Data and Emission Calculations

Facility Name	County	Solid Waste Permit Number	Facility Type	LFG Collection System?	Comprehensive or Partial LFG Collection System?	Tons Reported CY 2023 [1]	CO_2 Emissions [2]	CH_4 Emissions [2]	Total CO_2e Emissions
							(MT CO_2e)		
City of Durant Landfill	Bryan	3507001	Construction & Demolition Landfill	No	N/A	5,259	359	2,248	2,607
City of Broken Bow Landfill	McCurtain	3545008	Municipal Solid Waste Landfill	No	N/A	26,415	649	4,065	4,714
McCurtain County (Idabel) Landfill	McCurtain	3545011	Municipal Solid Waste Landfill	No	N/A	14,173	326	2,041	2,367
International Paper - Valliant Mill NHIW Landfill [3]	McCurtain	3545009	Non-hazardous Industrial Waste Landfill	No	N/A	--	--	--	89,506
City of McAlester Landfill	Pittsburg	3561012	Municipal Solid Waste Landfill	No	N/A	507	14	90	104
Alderson Regional Landfill [4]	Pittsburg	3561013	Municipal Solid Waste Landfill	Yes	Partial	86,538	--	--	18,362
McAlester Army Ammunition Plant NHIW Landfill	Pittsburg	3561014	Non-hazardous Industrial Waste Landfill	No	N/A	1,112	44	273	317
Clinton Lewis Construction Co. Landfill	Pushmataha	3564004	Municipal Solid Waste Landfill	No	N/A	37,325	817	5,116	5,933
						Total CO_2e Emissions	2,209	13,833	123,910

1. Values obtained from Annual Tonnage Reported from the Oklahoma Department of Environmental Quality, as reported here: https://www.deq.ok.gov/wp-content/uploads/2021/02/Annual_Tonnage_Reported.pdf

2. 2023 Emissions calculated via California Air Resources Board's (CARB) Landfill Gas Tool, using annual tons of waste reported from 2019-2024. See sample workbook here: https://ww2.arb.ca.gov/resources/documents/carbs-landfill-gas-tool. Emissions are determined using the equations from IPCC's Mathematically Exact First-Order Decay Model (2006 IPCC Guidelines), based on the percent waste that is degradable (ANDOC%), which is calculated using the following equation: $ANDOC\% = \sum WIPFRAC_i \times TDOC_i \times DANF_i$

where $WIPFRAC_i$ is the fraction of the ith component in the Waste-in-Place, $TDOC_i$ is the total degradable organic carbon fraction of the ith waste component, and $DANF_i$ is the decomposable anaerobic fraction of the ith waste component.

3. 2022 Industrial Waste Landfill (Subpart TT) emissions reported in the International Paper - Valliant Mill's RY2022 Greenhouse Gas report, obtained from the U.S. EPA's GHG Facility Level Information on Greenhouse gases Tool (FLIGHT), have been scaled up to CNO boundaries and population for McCurtain County for 2023 emissions. CH4 emissions from the FLIGHT tool were converted to CO2e basis using GWPs per IPCC AR6 7SM report, Table 7.SM.6, accessible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

4. 2022 emissions reported in the Alderson Regional Landfill's RY2022 Greenhouse Gas report , obtained from the U.S. EPA's GHG Facility Level Information on Greenhouse gases Tool (FLIGHT), have been scaled up to CNO boundaries and population for Pittsburg County for 2023 emissions. Population data is located in the "Activity Data - State of Oklahoma" table on the Activity Data tab.

Appendix B – Priority GHG Reduction Measures – GHG Reduction Quantification

Baseline emissions from lighting in Base Year 2023

Electricity consumption reduction from implementation of occupancy sensors

Percent of electricity consumes on a typical commercial building for lighting[1]	17%	
Annual Electricity Consumption in CNO Properties within scope of project [2]	8,188,764	kWh/yr
Electricity consumed for lighting in CNO properties	1,392,090	kWh/yr

[1] *From U.S. Energy Information Adminsitration (EIA) 2012 Commercial Buidlings consumption Survey (CBECS) Survey. Available here: https://www.eia.gov/consumption/commercial/reports/2012/lighting/*

GHG Emissions Factors

GHG	Emissions Factor[3] (lb/MWh)	GWP[4]
CO_2	970.4	1
CH_4	0.07	28
N_2O_2	0.01	273

[2] *Data provided is regarding usage for 250 CNO facilities.*

[3] *Emission Factor from EPA eGrid power profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO*

[4] *Global warming Potential (GWP) per IPPC AR6 7SM report, Table 7.SM.6, accesible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf*

Baseline Lighting GHG Emissions - 2023

GHG	Emissions, lbs/yr	CO_{2e}, metric tonnes/yr
CO_2	1,350,884	612.75
CH_4	100.23	1.27
N_2O_2	13.92	1.72
	Total	**616**

Air Pollution - Baseline Analysis- Year 2023

Air Pollutants Emission Factors[5]

	lbs/MWh
Sulfur Dioxide (SO_2)	0.3
Nitrogen Oxide (NO_x)	0.6

Baseline Air Pollution Estimate

		kg/yr
Sulfur Dioxide (SO_2)		**189**
Nitrogen Oxide (NO_x)		**379**

[5] *From U.S. EIA State Electricity Profile 2021 available here: https://www.eia.gov/electricity/state/oklahoma/*

R. M. #1 - Installation of Automatic Lighting in all CNO owned/operated properties

Electricity consumption reduction from implementation of occupancy sensors

Room Type	% Reduction [1]		
	Min	Max	Average
Conference Room	20%	65%	43%
Private Office	13%	70%	42%
Open Office	5%	35%	20%
Restroom	30%	90%	60%
Storage Area	45%	80%	63%
Warehouse	50%	90%	70
		Average:	49%

[1] *U. S. Department of Energy - Better Buildings - Fact Sheet on Wireless Sensors for lighting Energy Savings, Available here: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Wireless-Sensors-Guidance.pdf*

Percent of electricity consumed in a typical commercial building for lighting [2]	17%	
Annual Electricity Consumption in CNO Properties within scope of R.M. #1 [3]	8,188,764	kWh/yr
Reduction in electrciity consumption due to R.M. #1 implementation	687,924	kWh/yr

[2] *From U.S. Energy Information Adminsitration (EIA) 2012 Commercial Buidlings consumption Survey (CBECS) Survey. Available here: https://www.eia.gov/consumption/commercial/reports/2012/lighting/*

GHG Emission Factors

GHG	Emissions Factor[3] (lb/MWh)	GWP[4]
CO_2	970.4	1
CH_4	0.07	28
N_2O_2	0.01	273

[3] *Data provided is regarding usage for 250 CNO facilities.*

[3] *Emission Factor from EPA eGrid power profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO*

[4] *Global warming Potential (GWP) per IPPC AR6 7SM report, Table 7.SM.6, accesible here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf*

GHG Emissions Reduction from R. M. #1

GHG	Emissions, lbs/yr	CO_{2e}, metric tonnes/yr
CO_2	668	302.8
CH_4	49.53	0.63
N_2O_2	6.88	0.85
	Total	**304**

Benefits Analysis - Reduction in Air Pollution

Air Pollutants Emission Factors [6]

	lbs/MWh
Sulfur Dioxide (SO_2)	0.3
Nitrogen Oxide (NO_x)	0.6

Air Pollutans Emission Reduction from R.M. #1

	kg/yr
Sulfur Dioxide (SO_2)	**189**
Nitrogen Oxide (NO_x)	**379**

[6] *From U.S. EIA State Electricity Profile 2021 available here: https://www.eia.gov/electricity/state/oklahoma/*

R. M. #2 - Elimination of Single Use Plastics

Emission Factors [1] for Source Reduction of Plastics

Material	Current Mix of Inputs	100% Virgin Inputs	Average
	MTCO$_{2e}$/Short Ton of Material		
HDPE	1.420	1.520	1.470
LDPE	1.800	1.800	1.800
PET	2.170	2.210	2.190
LLDPE	1.580	1.580	1.580
PP	1.520	1.540	1.530
PS	2.500	2.500	2.500
PVC	1.930	1.930	1.930
Mixed Plastics	1.870	1.940	1.910
			1.860

[1] *U. S. EPA Waste Reduction Model (WARM), Documentation fpor GHG Emission and Energy Factors, Management Practices Chapter, Dec 2023, EPA-530-R-23-018, Exhibit 1-1. Available here: https://www.epa.gov/system/files/documents/2024-01/warm_management_practices_v16_dec.pdf*

Number of Employees using single use plastic bags/cutlery [2] | 400 | persons/day

[2] *Data provided is regarding usage for 250 CNO facilities.*

Average plastic cup use per capita in U.S. [3] | 0.27 | kg/person/day

[3] *2018 total p[er capita Municipal Solid Waste (MSW) daily per capita generation value of 4.9 pounds, with 12.2% of total MSW generated is plastics, as reported in the U.S. EPA's National Overview: Facts and Figures on Materials, Wastes, and Recycling. Available here: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials*

Quantity of total single use plastics eliminated [4] | 31.00 | short tons

[4] *Based on 5 days in the office year round*

<u>GHG Emission Reduction from R.M. #2</u>

Emission Reduction | 58 | metric tonnes CO$_{2e}$

R.M. #3 - Switching to LED lighting at all CNO owned/operated properties

Typical Energy Savings for LED lighting [1] | 75% | (compared to incandescent lighting)

[1] U.S. Department of Energy's Energy Saver resource. Available here: https://www.energy.gov/energysaver/led-lighting#:~:text=Residential%20LEDs%20%2D%20especially%20ENERGY,times%20longer%2C%20than%20incandescent%20lighting

Percent of electricity consumed in a typical commercial building for lighting [2] | 17%

[2] From U.S. Energy Information Adminsitration (EIA) 2012 Commercial Buidlings consumption Survey (CBECS) Survey. Available here: https://www.eia.gov/consumption/commercial/reports/2012/lighting/

Annual Electricity Consumption in CNO Properties within scope of R.M. #3 [3] | 8,188,764 | kWh/yr

[3] Data provided is regarding usage for 250 CNO facilities.

Reduction in electricity consumption due to R.M. #3 implementation | 1,044,067 | kWh/yr

<u>GHG Emission Factors</u>

GHG	Emissions Factor[4] (lb/MWh)	GWP[5]
CO_2	970.4	1
CH_4	0.07	28
N_2O_2	0.01	273

[4] Emission Factor from EPA eGrid power profiler for subregion SPSO. Available here: https://www.epa.gov/egrid/power-profiler#/SPSO

[5] Global warming Potential (GWP) per IPPC AR6 7SM report, Table 7.SM.6. Available here: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

<u>GHG Emissions Reduction from R. M. #3</u>

GHG	Emissions, lbs/yr	CO_{2e}, metric tonnes/yr
CO_2	1,013,163	459.56
CH_4	75.17	0.95
N_2O_2	10.44	1.29
	Total	**462**

Benefits Analysis - Reduction in Air Pollution

Air Pollutants Emission Factors [6]

	lbs/MWh
Sulfur Dioxide (SO_2)	0.3
Nitrogen Oxide (NO_x)	0.6

<u>Air Pollutans Emission Reduction from R.M. #3</u>

	kg/yr
Sulfur Dioxide (SO_2)	**142**
Nitrogen Oxide (NO_x)	**284**

[6] From U.S. EIA State Electricity Profile 2021 available here: https://www.eia.gov/electricity/state/oklahoma/