

Appendix C: Greenhouse Gas Inventory Methods and Sources

The greenhouse gas inventory conducted for the Central Iowa planning area in 2020 shows that the total estimated emissions amounted to 11,972,047 metric tons of gross carbon dioxide equivalent (mt CO₂e). These emissions were classified into different sectors based on their sources. EPA's Local Greenhouse Gas Inventory Tool (LGGIT) was used to develop the GHG Inventory under the accounting protocol of the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC). See the LGGIT inventory in Appendix D.

Carbon Dioxide Equivalent (CO₂e)

While carbon dioxide (CO₂) is the primary focus of fossil fuel reduction efforts due to its abundance in the Earth's atmosphere, it is not the only GHG. In fact, CO₂ has a global warming potential (GWP) lower than other GHGs. CO₂e attributes the impacts of other fossil fuels emitted, such as methane (CH₄) and nitrous oxide (N₂O), which have significantly higher Global Warming Potential (GWP).

Emissions data is expressed as CO₂e, or carbon dioxide equivalent. This is a standard unit for GHG contributions.

Table C1. Greenhouse Gases Global Warming Potential (GWP)¹

Kyoto Greenhouse Gases	Global Warming Potential
CO ₂	1
CH ₄	25
N ₂ O	298
Hydrofluorocarbons (HFCs)	124 - 14,800
Perfluorocarbons (PFCs)	7,390 - 12,200
Sulfur hexafluoride (SF ₆)	22,800
Nitrogen trifluoride (NF ₃)	17,200

¹ United Nations Climate Change (n.d.) Global Warming Potentials (IPCC Fourth Assessment Report). <https://unfccc.int/process-and-meetings/transparency-and-reporting/greenhouse-gas-data/frequently-asked-questions/global-warming-potentials-ipcc-fourth-assessment-report>.

GHG Emissions Summary Table

This inventory provides further details on the composition of emissions within each sector. The analysis shows that stationary emissions account for 22% of the total, indicating the contribution of activities such as heating with fossil fuels. Electricity consumption represents 40% of emissions, while mobile emissions from transportation make up 30% of emissions. Data for other sectors is summarized in Table C2.

Table C2. Central Iowa GHG Emissions by Source and Gas, 2020* (mt CO₂e)

*Note: In the limited cases where 2020 data wasn't available, the closest available year was used. See Table C5 for details.

Source	CO ₂	CH ₄	N ₂ O	Total (mt CO ₂ e)	% Total
Stationary Combustion	2,670,486	6,530	1,536	2,678,552	22%
Natural Gas	2,572,692	6,399	1,289	2,580,380	
Propane	97,794	131	247	98,172	
Mobile Combustion	3,564,316	153	1	3,564,470	30%
Residential On-road, Gasoline	2,229,570			2,229,570	
Residential On-road, Diesel	47,461			47,461	
Commercial/Institutional On-road, Gasoline	18,481			18,481	
Commercial/Institutional On-road, Diesel	426,742			426,742	
Commercial/Institutional Nonroad, all	842,062	153	1	842,219	
Solid Waste	-	137,821	-	137,821	1%
Wastewater Treatment	-	236,030	14,477	250,507	2%
Electricity - Location Based	4,738,048	14,085	19,227	4,771,361	40%
Residential	1,237,218	3,678	5,021	1,245,917	
Commercial/Institutional	2,618,330	7,784	10,625	2,636,739	

Industrial	882,450	2,624	3,581	888,704	
Ag & Land Management	-	-	569,335	569,335	5%
Urban Forestry	-172,095	-	-	-172,095	-1%
Total (Gross Emissions)	10,972,850	394,620	604,577	11,972,047	100%
Total (Net Emissions)	10,800,755	394,620	604,577	11,799,952	100%

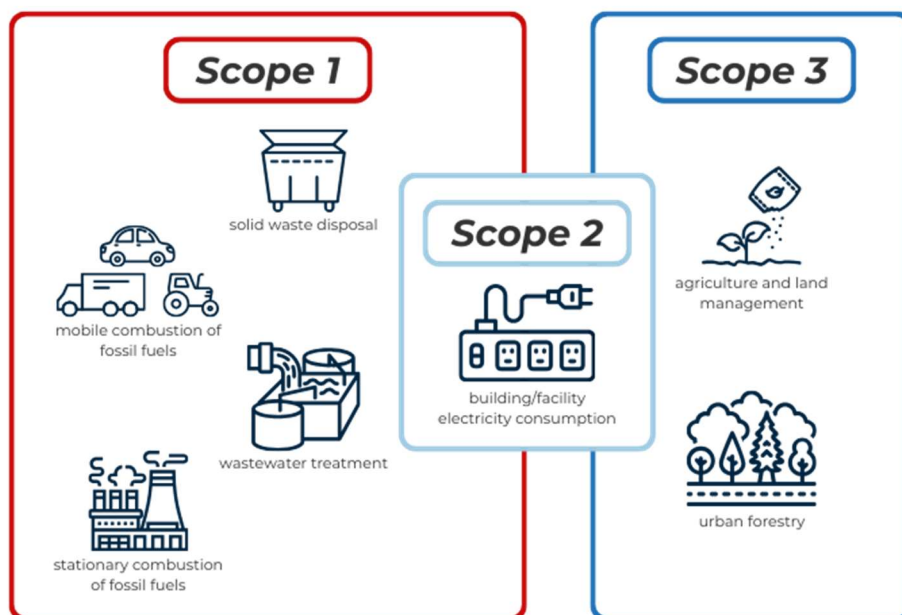
Table C3. Central Iowa GHG Emissions by Scope, 2020*

	Definition	Sources	% Total	Total (mt CO₂e)
Scope 1	All direct GHG emissions from activities taking place within the planning area. This scope covers emissions sources that are owned or controlled from within the community.	<ul style="list-style-type: none"> • Stationary Combustion of Fossil Fuels: Emissions from burning fossil fuels at fixed installations, such as power plants, boilers, and furnaces. • Mobile Combustion of Fossil Fuels: Emissions from burning fossil fuels in mobile sources, such as vehicles and equipment. • Solid Waste Disposal: Emissions from the decomposition of waste in landfills, including the release of methane, a potent greenhouse gas. • Wastewater Treatment: Emissions from the treatment of wastewater, which can include the release of methane and nitrous oxide from biological sources. 	55%	6,631,350
Scope 2	Energy-related indirect emissions that result as a consequence of consumption of grid-supplied electricity.	<ul style="list-style-type: none"> • Building/Facility Electricity Consumption: Emissions resulting from the use of electricity in the community. 	40%	4,771,361
Scope 3	All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and	<ul style="list-style-type: none"> • Agriculture & Land Management: Emissions resulting from agricultural practices. This inventory includes emissions generated from fertilizer use, but not livestock production, 	3%	397,241

production of purchased materials and fuels, outsourced activities, waste disposal, etc.	crop cultivation, and land-use changes. • Urban Forestry: Emissions and removal of greenhouse gases associated with the management and preservation of urban trees and forests.
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NOTE: These numbers are based on the best calculations and estimations available by scope. Though they do not add up to 100%, Polk County would rather attribute correctly based on LGGIT outputs rather than double count any particular source. The comprehensive GHGI conducted in the CCAP process will aim to get even closer to 100% accounting of scope as the data will be more directly from sources of emission and less estimations.

Figure C1. GHG Emission Scopes²



ELECTRICITY CONSUMPTION

The electric power sector was the largest emissions source, accounting for 40% of total Central Iowa GHG emissions in 2020.

MOBILE COMBUSTION

² U. S. Environmental Protection Agency. (n.d.). Greenhouse Gases at EPA.

Transportation activities were the second-largest source (30%) of Central Iowa GHG emissions in 2020. This subsector includes emissions resulting from transportation activities, including emissions from cars, trucks, airplanes, and ships. All heavy-duty vehicles are categorized as commercial/institutional. All other vehicles are categorized as residential. All nonroad emissions are categorized as commercial/institutional.

STATIONARY COMBUSTION

In 2020, stationary source combustion from natural gas and propane use accounted for 22% percent of GHG emissions in the planning area. Natural gas is widely used for heating, electricity generation, and industrial applications. Liquid propane is often used as a fuel for heating and cooking.

URBAN FORESTRY

In the inventory, the net CO₂e removed from the atmosphere by urban trees in Central Iowa amounted to approximately -1% of the region's total GHG emissions. This negative percentage indicates that urban trees in Central Iowa had a slight net carbon sequestration effect, meaning they absorbed more CO₂e than they emitted.

AGRICULTURE & LAND MANAGEMENT

Agriculture made up approximately 5% of total GHG emissions. A significant portion of these emissions can be attributed to the use of synthetic fertilizers in agricultural practices. Synthetic fertilizers release N₂O, a potent greenhouse gas, during their application and subsequent soil processes. However, it's important to note that the inventory did not include other agricultural contributions to GHG emissions, such as methane emissions from livestock or manure management. These emissions are significant and can vary depending on the agricultural practices employed. Integrating these emissions into future inventories will be essential for developing a more accurate understanding of the agriculture sector's overall emissions and designing effective mitigation measures.

SOLID WASTE

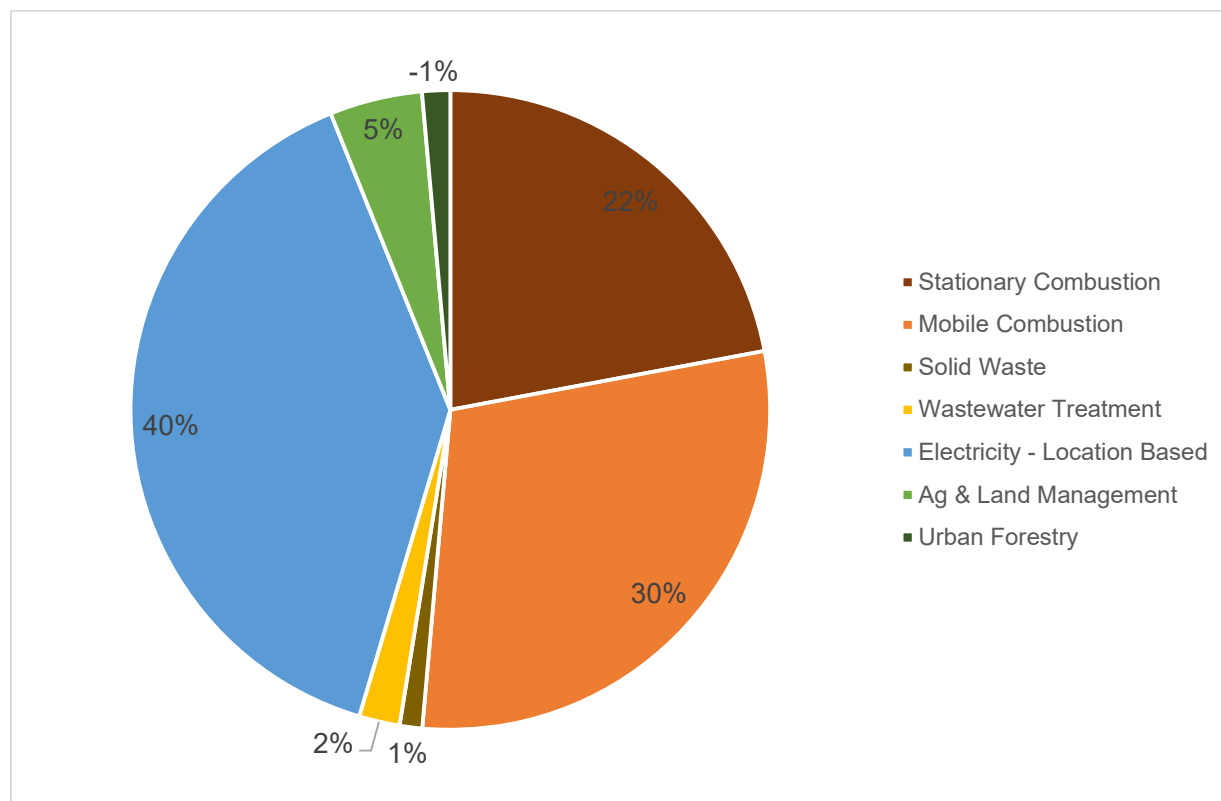
The solid waste sector encompasses various activities such as landfilling and anaerobic digestion, which collectively accounted for approximately 1% of GHG emissions. Landfills are a significant contributor to these emissions due to the decomposition of organic waste, which generates methane. Methane is released when organic waste breaks down in anaerobic (oxygen-deprived) conditions. Anaerobic digestion, on the other hand, involves the controlled decomposition of organic waste to produce biogas, which can be used as a renewable energy source.

WASTEWATER TREATMENT

Wastewater treatment accounted for approximately 2% of total emissions. Wastewater treatment plays a critical role in maintaining public health and protecting the environment by removing contaminants from wastewater before it is discharged back into natural water bodies. However, the process of treating wastewater itself can contribute to greenhouse gas (GHG) emissions. Biological processes within the treatment systems, particularly during the breakdown

of organic matter, generate methane and nitrous oxide. These emissions occur during the natural decomposition of sewage by microorganisms.

Figure C2. Central Iowa GHG Emissions by Sector, 2020*



GHG Inventory Methods

Polk County identified, evaluated, and utilized existing data resources to develop a local inventory of the major sources of GHG emissions within the planning area. This inventory was conducted for the year 2020 due to the availability of data from highest quality sources (Table C4). In the instances where data for 2020 was unavailable, the closest available year was substituted. The vast majority of the GHGI uses 2020 data. For additional information on methods and quality assurance, see the Quality Assurance Project Plan (QAPP) in Appendix I.

Table C4. Data Quality Ranking Hierarchy³

Quality Rank	Source Type
Highest	Federal, state, and local government agencies
Second	Consultant reports for state and local government agencies
Third	Non-governmental organization studies; peer-reviewed journal articles; trade journal articles; conference proceedings
Fourth	Conference proceedings and other trade literature: non-peer-reviewed
Fifth	Individual estimates (e.g., via personal communication with vendors)

Table C5. Sectors and Years Included in GHGI

Sector	Inclusion	Inventory years
Mobile Combustion	Yes	2020
Stationary Combustion	Yes	2020
Electricity Consumption	Yes	2020
Solid Waste	Yes	2019, 2022
Urban Forestry	Yes	2011
Agriculture & Land Management	Yes	2015, 2016
Water Use	No*	-
Waste Generation	No*	-
Wastewater Treatment	Yes	2019, 2021, 2022

³ Polk County. 2023. *Des Moines MSA Quality Assurance Project Plan*.

**Not occurring in the region. Water is not being imported. Waste is not being exported.*

Data Sources

Sector	Source
Mobile Combustion	Iowa Department of Transportation https://iowadot.gov/ EPA's Motor Vehicle Emission Simulator (MOVES) https://www.epa.gov/moves
Stationary Combustion	National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) Platform https://maps.nrel.gov/slope U.S. Energy Information Administration https://www.eia.gov/ U.S. Census Bureau https://www.census.gov/
Electricity Consumption	NREL SLOPE https://maps.nrel.gov/slope
Solid Waste	EPA's Facility Level Information on GreenHouse gases Tool (FLIGHT) http://ghgdata.epa.gov/ghgp/main.do South Dallas County SLF Waste Volumes https://www.sdclandfill.com/reports
Urban Forestry	National Land Cover Data (NLCD) 2011 https://www.usgs.gov/centers/eros/science/national-land-cover-database
Agriculture & Land Management	EPA Ag Land Management County Regional Guidance https://www.epa.gov/system/files/documents/2023-10/ag_land_management_county_regional_guidance_9.20.23_508.pdf

EPA's State Inventory Tool

<https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool>

Wastewater
Treatment

Iowa Department of Natural Resources (NPDES)

<https://www.iowadnr.gov/Environmental-Protection/Water-Quality>

U.S. Census Bureau

<https://www.census.gov/>
