

2022 Community Inventory of Greenhouse Gas Emissions – Henry County, Virginia

Introduction

Henry County is a geographically large, rural jurisdiction in south central Virginia located along the state boundary with North Carolina. The county surrounds the City of Martinsville and includes the Town of Ridgeway, as well as a number of unincorporated towns. The county’s population in 2022 was 49,906 and 20,516 households (U.S. Census Bureau, 2023).

The county is currently participating in the first cohort of George Mason University’s (GMU) Local Climate Action Planning Initiative. In the first phase of the program, greenhouse gas (GHG) emissions produced by the energy consumption from the county’s activities were estimated for 2022. This community-scale inventory (as opposed to a more narrowed government operations inventory) captured the county’s energy consumption across nine categories: residential, commercial, industrial, transportation, solid waste, water and wastewater, agriculture and land use,¹ process and fugitive emissions, and upstream impacts of activities. This inventory uses the guidelines established by the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC) published by the World Resources Institute and partners. The results of this analysis are intended to inform subsequent climate action planning strategy development in the spring.

The GMU team worked closely with a team of county staff members to collect the necessary energy consumption data from local government departments, utility companies, state agencies, and other entities through data requests. Data was also taken from public resources, giving the data varying levels of robustness and accuracy depending on the source. The team conducted calculations and input data into an emissions management software tool ClearPath from the nonprofit ICLEI. Although emissions included other GHGs, such as methane or nitrous oxide, all GHGs were converted to metric tons carbon dioxide equivalent (MtCO_{2e}) to produce a standard measurement of their climate change impacts.

Total Emissions and Scope

Henry County’s total GHG emissions in 2022 are estimated to be 809,659 MtCO_{2e}. This is 16.2 MtCO_{2e} per resident, which is 3.2 MtCO_{2e} higher than the national average (World Bank, 2023). Transportation and mobile sources comprised one-third of total emissions, and transportation, industrial, and residential energy use were responsible for over 80% of total community emissions (Figure 1). Aggregated emissions are useful for setting community reduction targets against a determined baseline to allow for high-level tracking of reduction progress.

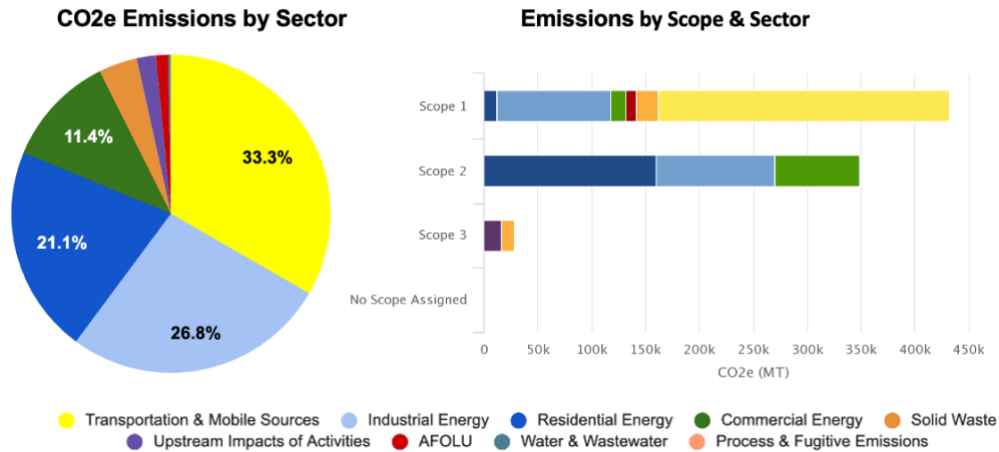
Figure 1: Sector Emissions

Sector	CO _{2e}	Percentage
Transportation & Mobile Sources	269,951	33.3%
Industrial Energy	217,056	26.8%
Residential Energy	170,859	21.1%
Commercial Energy	92,216	11.4%
Solid Waste	31,615	3.9%
Upstream Impacts of Activities	15,738	1.9%
Agriculture, Forestry, & Land Use (AFOLU)	9,984	1.2%
Water & Wastewater	2,012	0.2%
Process & Fugitive Emissions	228	0.0%
Total CO_{2e}	809,659	

To provide further insight into jurisdictional control over the emissions and subsequent reduction targets, the GPC distinguishes emissions by scope to identify where specifically emissions are produced. Scope 1 refers to emissions from sources located within the county’s jurisdictional boundaries. Scope 2 is indirect emissions from the use of grid-supplied electricity within the jurisdictional boundaries. Scope 3 emissions are all other emissions that occur outside the jurisdictional boundaries as a result of activities taking place within the county (Fong et al., 2021, 35). These scopes, depicted by Figure 2, are helpful for planning emissions mitigation according to emissions produced directly or indirectly by the county.

¹ The complete name of this category is agriculture, forestry, and other land use (AFOLU).

Figure 2



Emissions by Sector

Transportation and Mobile Sources (33.3%)

Transportation and other mobile source activity was the largest sector of emissions in the county, resulting in 269,951 MtCO_{2e}. As a rural county, passenger vehicle use is the primary driver of these emissions at 68.5% (Figure 3). This includes all standard gasoline motorcycles, cars, vans, SUVs, and pick-up trucks. The next largest source is freight (i.e. semi-trucks and tractor trailers) at just under 18.2%. The final 10% of transit emissions are from a number of sources, including off-road equipment (agriculture, construction machinery, logging equipment, landscaping engines, etc.), passenger buses, trains, and two recreational sources - the Philpott Lake Marina and the Martinsville Speedway.

Figure 3

Transportation Sector	CO2e	Percentage
Passenger Vehicles (Gasoline)	184,637	68.40%
Freight (Diesel)	49,012	18.16%
Off-road equipment (Diesel)	13,858	5.13%
Off-road equipment (LNG)	7,226	2.68%
Off-road equipment (Gasoline)	7,086	2.62%
Passenger Buses (Diesel)	4,391	1.63%
Locomotives	2,770	1.03%
Off-road equipment (CNG)	590	0.22%
Martinsville Speedway	273.51	0.10%
Philpott Marina (Gasoline)	107	0.04%
Total CO2e	269,951	

The data was collected from a variety of sources. The primary road emissions were calculated using the annual report by the Virginia Department of Transportation (VDOT) of vehicle miles traveled on county roads. The off-road data was provided by the EPA's 2020 National Emissions Inventory and aggregated at the county level, greatly improving its reliability. Lastly, data for recreational activities and events were provided through direct reports from the Henry County Department of Recreation and the Martinsville Speedway. Assumptions were record-specific, but included categorizing fuel types for different classes of on-road vehicles and specific conditions that impacted fuel use in recreational transit. Additionally, the VDOT data collection does not distinguish buses by services, which includes Piedmont Area Regional Transit, Henry County Public Schools, regional bus companies (e.g. Greyhound), or other miscellaneous bus activity within the county. It does not capture annual passenger data, route vehicle use, nor non-active service mileage, which can fluctuate.

Industrial Energy (26.8%)

The industrial sector emitted 217,056 MtCO_{2e} or around 26.8% of Henry County's total emissions. Consumption of electricity from Appalachian Power was the largest contributor to the

industrial sector, with 51.0% (110,595 MtCO_{2e}) of the industrial sector coming from these scope-2 emissions. Emissions were calculated using the EPA's Emissions and Generation Resource Integrated Database (eGRID), which provides the output emissions rate (lb/MWh) of the electricity generation in the RFC-West subregion, which services Henry County. Stationary combustion made up the rest of the emissions for the industrial sector, comprising of 59.5% natural gas, 27.0% coal, and 8.9% distillate fuel.

Natural gas data was directly received from Southwestern Virginia Gas Company. Other liquid and combustible fuel data was collected from the Energy Information Agency (EIA)'s industrial energy consumption estimates for Virginia. The data taken from the EIA was for Virginia as a whole, so using U.S. Census Bureau job data, a ratio was created to estimate Henry County's consumption of each fuel type present in the data (coal, kerosene, propane/HGL, etc.). Since this data was calculated creating a ratio, it might not map perfectly to Henry County's real consumption.

Residential Energy (21.1%)

The residential sector includes all emissions from electricity and combustible fuel consumption, which resulted in 170,860 MtCO_{2e}. Appalachian Power provided the total electricity consumption of all household accounts, which was classified as scope 2 emissions and calculated using the eGRID output emissions rate. The Southern Virginia Gas Company provided household natural gas consumption, which was classified as scope 1 emissions. Other stationary fuel sources included coal, liquid natural gas, wood, and kerosene, which was calculated using the household ratio from the 2021 American Community Survey House Heating Fuel.

Commercial Energy (11.4%)

The commercial sector emitted 92,216 MtCO_{2e} or 11.4% of Henry County's emissions. 85% (78,558 MtCO_{2e}) of the commercial sector's emissions comes from consumption of utility electricity from AEP. All public sector electricity customers (government accounts) were recorded under commercial electricity. Electricity consumption associated with water and wastewater were subtracted from the total amount and recorded under that section (see page 4). Stationary combustion made up the rest of the emissions for the commercial sector, with natural gas being the largest fuel type at 53.68%, motor gasoline (19.83%) being the second largest, then distillate fuel (15%), and other fuels making up the rest.

The non-natural gas data was collected from the Energy Information Agency (EIA)'s industrial and commercial energy consumption estimates for Virginia. The data taken from the EIA was for Virginia as a whole, so using Census Bureau job data, a ratio was created to estimate Henry County's consumption of each fuel type present in the data (coal, kerosene, propane/HGL, etc.). Since this data was calculated creating a ratio, it might not map perfectly to Henry County's real consumption. Natural gas data was directly received from Southwestern Virginia Gas Company. Finally, some emissions from the water and wastewater sector were included within the commercial sector's emissions.

Solid Waste (3.9%)

Solid waste generation and landfill-associated emissions were 31,619 MtCO_{2e}, which accounted for 3.9% of the county's total emissions. Emissions are calculated by the weight of waste that is generated by the locality, the composition of that waste (municipal solid waste, compost, recycling, etc.), and where that waste ultimately decomposes. This can be situationally complex, depending on interjurisdictional arrangements and regional services. There are two significant sources of solid waste emissions in Henry County. The retired Martinsville Sanitary Landfill accounts for roughly two-thirds of solid waste emissions (19,971 MtCO_{2e}) and the other third is from annual waste generation (11,645 MtCO_{2e}). This annual waste is collected at the First Piedmont Transfer Station, where it is sorted and disposed of beyond the county's boundaries. The total volume of solid waste at the transfer station in 2022 was provided by the Virginia Department of Environmental Quality (VDEQ). The total waste reported from the City of

Martinsville's Refuse Department was subtracted from the VDEQ report to isolate the solid waste generated within the county. This is a primary scope 3 emissions source.

Agriculture, Forestry, and Other Land Use (1.2%)

Agriculture made up 1% of emissions for the County, well below the national average of 11% (Environmental Protection Agency [EPA], 2021) - both figures excluding forestry and land-use. Headcounts on livestock and crops were taken from the U.S. and multiplied by emissions factors from the International Panel on Climate Change (IPCC) to estimate methane emissions enteric fermentation and manure management for livestock and nitrous oxide emissions for crops (Gavrilova, et al. 2019). Livestock included dairy and beef cattle, sheep, poultry, and swine. Wheat was the only crop. Nearly all emissions in agriculture (99%) came from cattle, though beef cattle had a noticeably larger impact on methane emissions than dairy cattle (United States Department of Agriculture, 2020).

Other land use refers to the emissions of land-use changes across forestland, cropland, grassland, wetlands, settlements, and other uses. Per the GCP guidelines, forestry and other land change emissions were excluded (recorded as "information only"). If forestry and other land use change emissions were included, the AFOLU sector emission would increase to 11%. However, it would also require accounting for natural carbon sequestration and flux of forestland and greenspace, which is roughly a net 392,000 MtCO_{2e} fluctuation. Land conservation can be a valuable way to offset emissions, as forestry and land use in the County creates a larger net sink than the national net sink from forestry and land use of 12% (EPA, 2021). The largest emitter within forestry and land use comes from deforestation of forest land to grasslands. Exact numbers are not included due to the tool used using outdated or not high enough quality data for their calculations.

Water & Wastewater (0.2%)

The water and wastewater sector consists of emissions produced from water extraction, treatment, and wastewater treatment for residents and businesses within the County. Estimates of emissions were based on electricity consumption data provided by the Henry Public Service Authority (PSA) for drinking water and from the Piedmont Lagoon Sewage Treatment Plant and the City of Martinsville for wastewater treatment. There was a total of 2,013 MtCO_{2e} from the sector, in which electricity used to extract, treat, and distribute drinking water was responsible for 64% of the sector's emissions. Emissions from wastewater treated at the Piedmont location are Scope 1 emissions since the plant is located within the county, while emissions from wastewater treated in and imported from Martinsville are Scope 3 emissions. Martinsville wastewater treatment contributed to 35% of the sector's emissions.

Emissions from this sector are underestimated because data was not distinguished from electricity consumption in other categories. Electricity demand of private wells and septic systems are assumed to be captured in residential, commercial, or industrial electricity use. However, non-electric private septic emissions were not calculated, which contributes to a conservative estimation.

Upstream Impact of Activities and Fugitive Emissions (1.9%)

Upstream and fugitive emissions are calculations of the energy systems' inefficiencies; essentially the extra energy that is expended in grid electricity and natural gas infrastructure when those sources of energy are consumed. At a grid loss factor of 4.5%, an additional 15,700 MtCO_{2e} were emitted from the County's grid electricity consumption. Due to the typical loss through transmission, this is classified as scope 3 emissions. Similarly, fugitive emissions focus on the county's total natural gas consumption. Using a standard 0.3% leakage rate, an additional 228 MtCO_{2e} were emitted. Given that natural gas loss takes place at point of consumption, this is classified as scope 1.

Work Cited

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