



Maryland
Department of
the Environment

Maryland's GHG Inventory



**Maryland Commission on Climate Change
Scientific and Technical Working Group**

June 20, 2017

Why an Emissions Inventory?

- Required by the GGRA
 - 3 Year Increments for Full Inventories
 - Data collected annually
- Track emissions relative to the GGRA
- Trends - Going up? Going down?
- Advises regulations
- Most importantly ... **identifies large and small source categories to provide focus for reduction opportunities**



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Maryland's GHG Inventory

Overview

- The Greenhouse Gas Reduction Act (GGRA) requires MDE to report on the statewide greenhouse gas inventory every three years
 - Most recent update released based on 2014 data
 - Next update will be based on 2017 data
- 2014 Inventory covers six types of GHGs, including methane
- Emissions were estimated bottom-up using generally accepted principles and guidelines
 - Maryland specific data to the extent possible

Greenhouse Gas	GWP
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous Oxide (N ₂ O)	310

- Equivalent CO₂ (CO₂e) was calculated using global warming potentials (GWP) from the IPCC 2nd Assessment Report



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Source Categories

- Electricity Use (Consumption)
- Residential, Commercial, and Industrial Fuel Use
- On-road Mobile Sources
- Non-road Mobile Sources
- Fossil Fuel Industry
- Industrial Processes
- Agriculture
- Waste Management
- Sinks



Maryland's GHG Inventory

Methods and Data Sources

- Based upon the very best available data
 - Calculated bottom-up using widely accepted principles and guidelines
 - *Maryland-specific* whenever possible
- Estimation/calculation process varies for each source category
 - Mobile source emissions (both on-road and non-road) are generated using a well-accepted EPA model with inputs from data sets maintained by SHA, MDE, MVA and EIA
 - Emissions from the majority of point sources are directly measured
 - Non-point source calculations utilize state-specific consumption data, fuel-specific carbon content coefficients and EPA established emissions factors and methodology

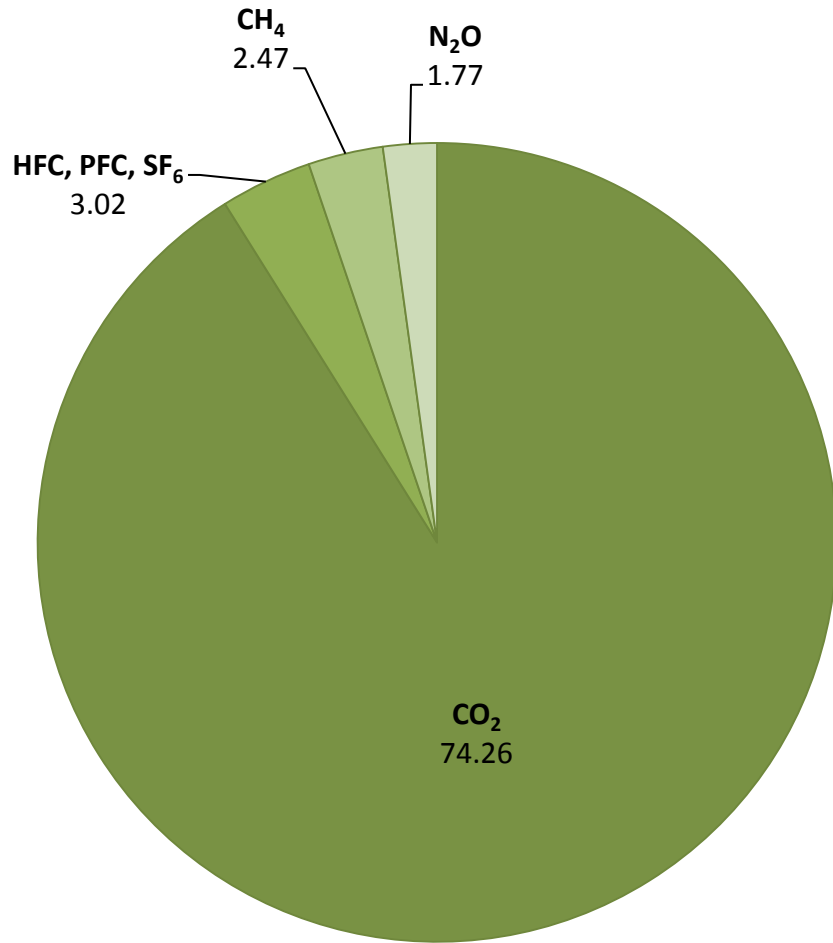


Alexandra Fries, IAN UMCES (ian.umces.edu/imagelibrary/)

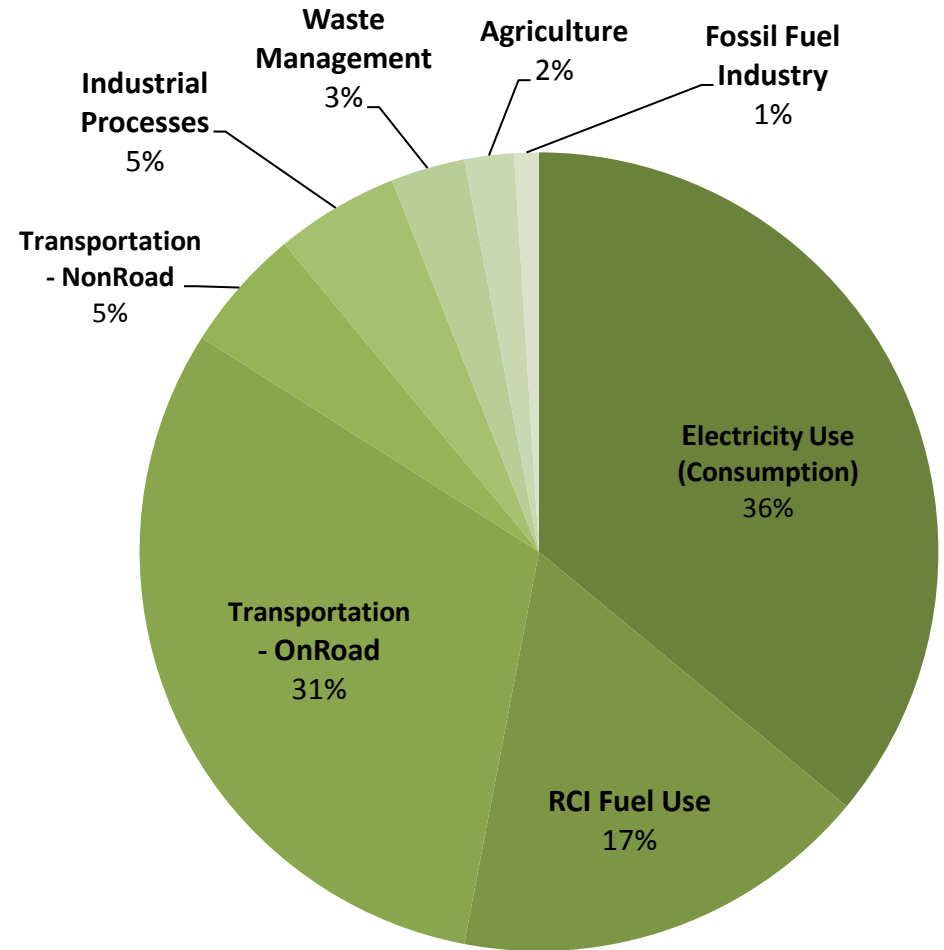


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2014 Results



2014 GHG Emissions
MMtCO₂e



2014 GHG Emissions by Sector

2014 Results

High level of confidence on over 90% of the inventory

CO ₂ emissions from MD EGUs were compiled from CEMS/Emissions Certification Reports and cross-checked against two other reporting programs	21.5%
PJM provides both the fuel mix information and CO ₂ emission rates for each fuel type to determine emissions from imported electricity	17.1%
EPA's well-accepted MOVES model was used to estimate on-road mobile emissions as well as most off-road mobile emissions	34.6%
R/C/I Fuel Use emissions estimates were calculated using MD specific fuel consumption data and carbon content coefficients specific to each fuel	17.1%



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Sinks

Organic Biomass

Forest Carbon Flux

- Sequestration in above- and below-ground biomass, dead wood, litter, and soil organic carbon
- Removal in wood products (in use and in landfills)
- Data:
 - State forest-carbon stock (1990-2009) (USDA Forest Service, Carbon Calculation Tool)
 - State harvested wood stock (1987, 1992, and 1997) (USDA Forest Service)
- Calculations:
 - Stock-difference method to assess change over time in forest-carbon stock
 - Average annual change in harvested wood stock



Jane Hawkeye, IAN UMCES
(ian.umces.edu/imagelibrary/)

$$\begin{array}{l} \text{Emissions or} \\ \text{Sequestration} \\ \text{(MMTCO}_2\text{e)} \end{array} = \begin{array}{l} \text{Aboveground} \\ \text{Biomass} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Belowground} \\ \text{Biomass} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Dead Wood} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Litter} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Soil Organic} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Wood} \\ \text{Products} \\ \text{Carbon Flux} \end{array} + \begin{array}{l} \text{Landfills} \\ \text{Carbon Flux} \end{array}$$

Sinks

Organic Biomass



Urban Trees

- Sequestration in urban tree cover
- Data:
 - Maryland's urban area, and percent urban area with tree cover (Maryland Forest Services)
- Calculations:

$$\text{Sequestration (MMTCO}_2\text{e)} = \text{Total Urban Area} \times \text{Urban Area with Tree Cover (\%)} \times \text{Carbon Sequestration Factor}$$

Landfilled Biomass

- Yard trimmings and food scraps which store carbon in biomass
- Data and Calculations:
 - Amount of landfilled yard trimmings and food scraps (MDE Solid Waste Program), apportioned to grass, leaves and branches (default data)
 - Carbon content of each waste category (default data)
 - Change in landfill carbon stocks between inventory years (IPCC methodology) from added stock and decomposition



Sinks

What Don't We Include?

Wetlands and Waterways

- Vegetated coastal wetlands can sequester soil carbon, which tends to accumulate under anaerobic conditions
- Wetlands also generate CH₄ emissions due to anaerobic decomposition

Why Isn't it Included?

- There is no EPA-approved methodology to calculate carbon flux in vegetated coastal wetlands at the state level
 - Data (NOAA) is available only at the continental level
- Not included in EPA SIT software LULUCF module for calculating net CO₂ flux



Ben Fertig, IAN UMCES

Agricultural Soils Management

- CO₂ emissions from liming and urea fertilizer applications; CH₄ and N₂O emissions from manure management; and N₂O emissions from fertilizer application, N-fixation by legumes, and crop residues are all included in the inventory
- Management can also result in net fluxes of soil carbon content, which are not included

Why Isn't it Included?

- There is no EPA-approved methodology for calculating changes in soil carbon content from management practices
- Not included in EPA SIT software LULUCF module for calculating net carbon dioxide flux



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2014 Results

Total Emissions (MMtCO₂e)	92.67
Total Sequestered (MMtCO₂e)	(11.78)
Forest Carbon Flux	(10.50)
Above-ground Biomass	(7.48)
Below-ground Biomass	(1.42)
Wood Products and Landfills	(0.72)
Dead Wood	(0.58)
Litter	(0.23)
Soil Organic Carbon	(0.05)
Urban Trees	(1.09)
Landfilled Yard Trimmings and Food Scraps	(0.19)
Landfilled Food Scraps	(0.07)
Leaves	(0.06)
Branches	(0.05)
Grass	(0.01)



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Questions ?

