What are SLCPs?

Short-lived climate pollutants (SLCPs) are air pollutants that have relatively short lifetime in the atmosphere and a warming influence on our climate. As opposed to carbon dioxide, which has an atmospheric lifetime of about 100 years, SLCPs have an atmospheric lifetime of a few years to even a few days. The most common SLCPs are methane, black carbon, and hydrofluorocarbons (HFCs).

- Methane is the second most emitted greenhouse gas in the US, accounting for about 10% of national greenhouse gas emissions. Emissions of methane also contribute to ground level ozone. Methane is the principal component of natural gas. About 60% of all methane emissions are anthropogenic and are expected to increase. The primary sources are from agriculture, waste treatment, and the oil and gas sectors. Capturing methane from these sources is cost effective, can improve air quality, provide fuel for vehicles and industry and displace other more carbon-intensive fossil fuels.

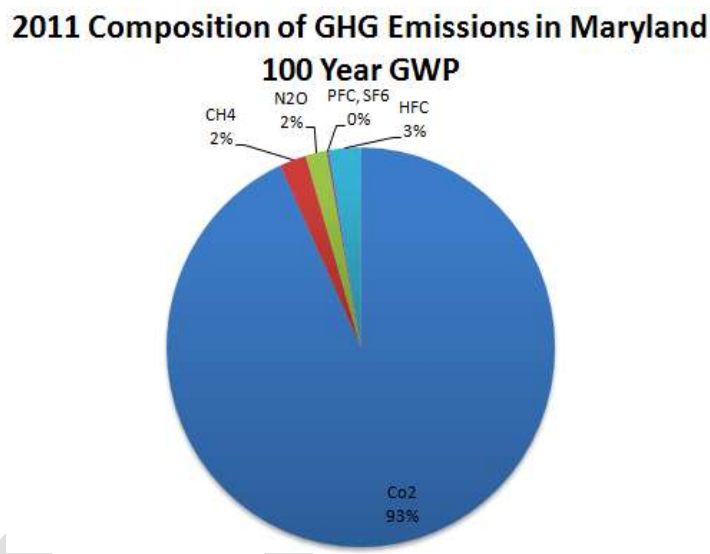
- Black Carbon is a component of fine particulate matter, which is the result of incomplete combustion of fossil fuels and biomass, particularly from older diesel engines and forest fires. Black Carbon has been identified as a risk factor for premature death. It warms the atmosphere by absorbing solar radiation, influences cloud formation, and darkens the surface of snow and ice, which accelerates heat absorption and melting.

- Hydrofluorocarbons, or HFCs, are industrial chemicals primarily used for refrigeration and air conditioning. HFCs were created to replace extremely volatile CFCs and HCFCs that were originally used for the same purposes and were found to be ozone-depleting. After the Montreal Protocol phased out these chemicals, HFCs became prominent and while they aren't ozone depleting, they have a high global warming potential. Most HFCs emissions are from leaks in refrigeration and air-conditioning systems.

Pollutant	Lifetime (years)	20 year GWP	100 year GWP
CO_2	100	1	1
CH_4	12	72	34[a]
Black Carbon	Days to weeks	3,200	900
HFCs	13	3,830	140-11,700

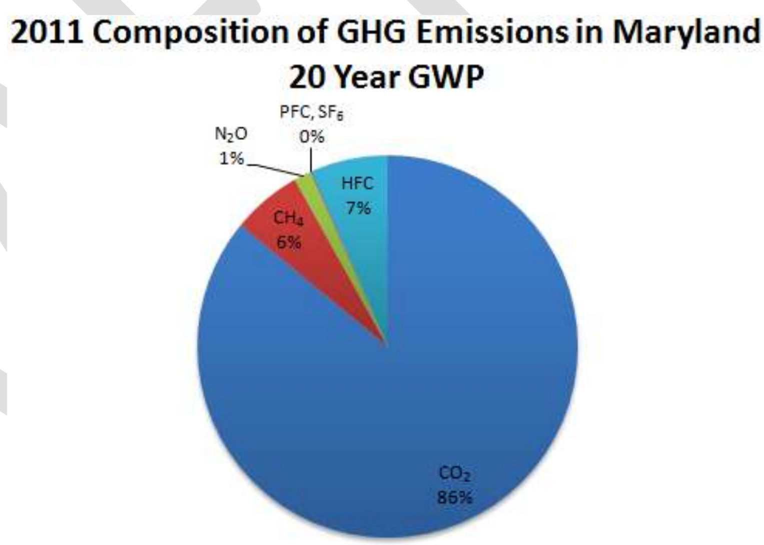
[a] To reflect the most current IPCC report, the 100-year GWP is updated from 21 (the value EPA currently uses) to 34

In order to show the short term climate significance of these pollutants, all of the data presented with a 100 year global warming potential has been converted to a 20 year global warming potential as seen in the adjacent figures. SLCPs have a much smaller GWP over 100 years so they may appear to have less of an impact; however their effect in the near-term (20 years) can be significant. For example, methane has a 100 year GWP of 25, but a 20 year GWP of 72. This factor makes it 72 times more harmful than CO_2 in terms of warming.



<u>Why are they SLCPs important?</u>

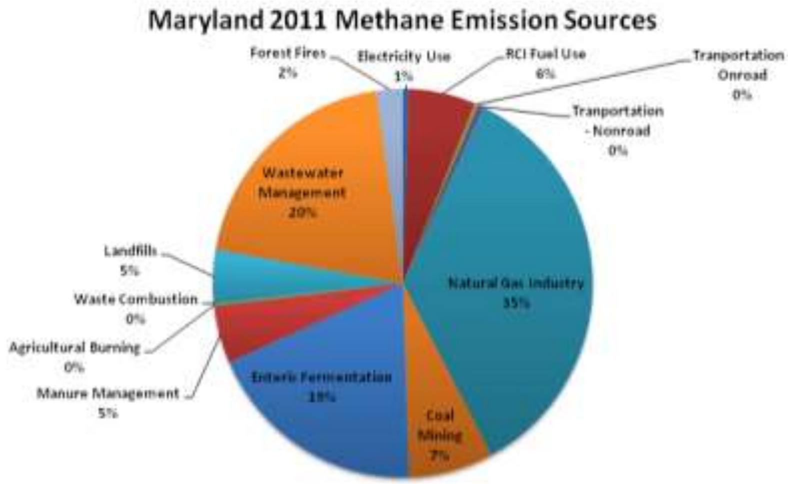
Despite being short lived, SLCPs disproportionately contribute to climate change, based on how they add heat the atmosphere. Their warming potential can be tens, hundreds, or even thousands of times greater than that of CO2. Reducing emissions of SLCPs would provide immediate benefit - far sooner than reductions in CO2 due to how little time they remain in the atmosphere. In addition to the environmental benefits of reducing SLCPs, there would also be a large public health impact.



Black carbon exposure can lead to cardiovascular and respiratory illnesses, and ground-level ozone formed by methane is harmful to agriculture and public health. The UN Environment Programme reported that an aggressive policy towards reducing SLCPs would avoid 2.4 million premature deaths world wide by 2030 while also reducing global warming between now and 2040 by half a degree. Wide-spread and immediate benefits from cost-effective and readily available reduction strategies could have measureable positive impacts on global climate.

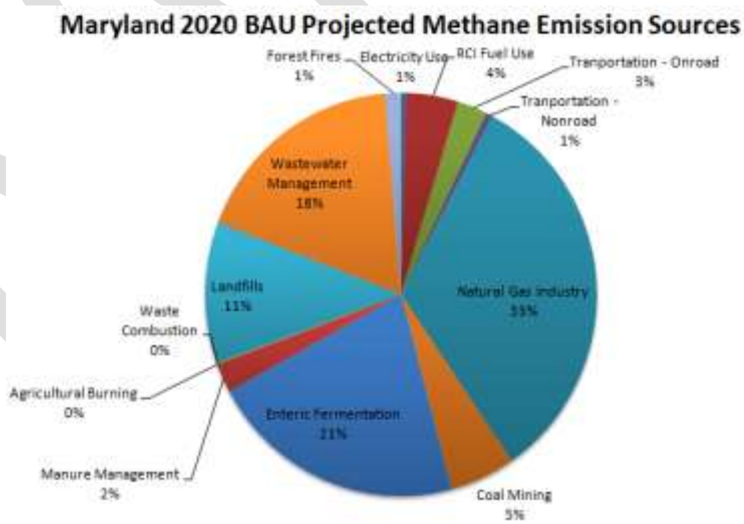
SLCPs in Maryland

Short-lived climate pollutants make up only about 13% of GHG emissions in Maryland when measured over a 20-year period. In other states, like California, SLCP's contribute as much as 40% of total GHGs. Despite contributing such a small fraction of total GHG emissions, Maryland is still reviewing policies and implementing programs to reduce emissions of SLCPs in the state.

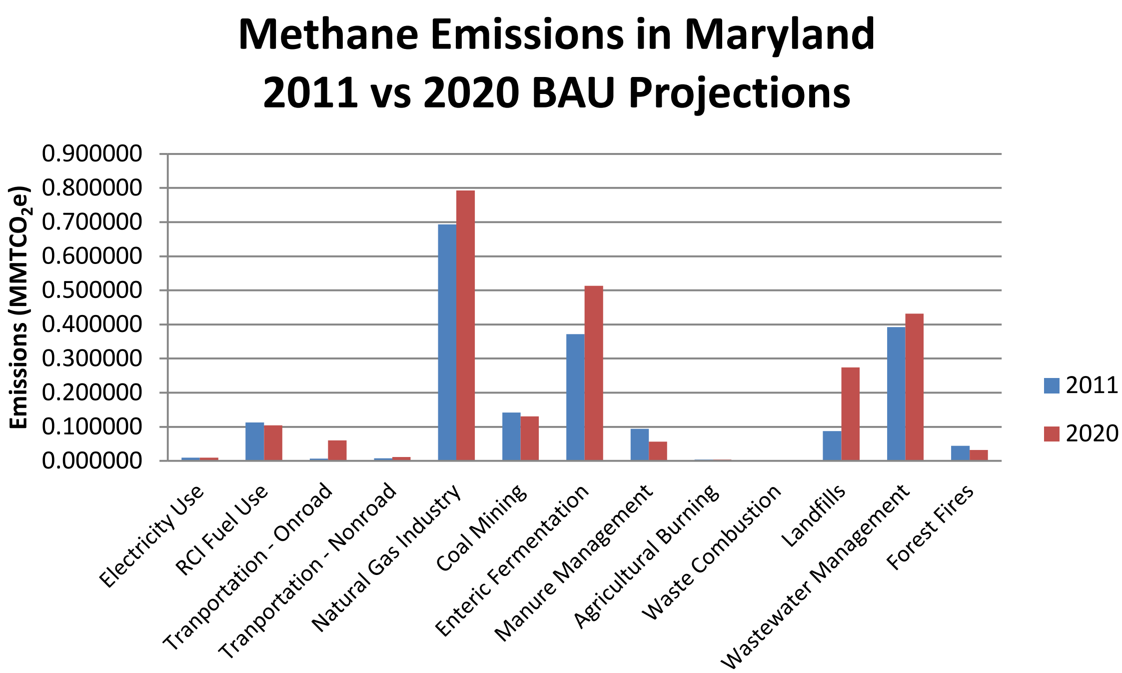


Several uncertainties exist related to methane emissions due to the nature of certain emission sources. For emissions from enteric fermentation and manure management, the data relies on animal populations and other factors that can be unreliable. There are similar issues estimating contribution from landfills and forest fires.

In 2011, the natural gas industry provided about 35% of the total methane emissions in Maryland, while the agricultural sector (enteric fermentation, manure management, and agricultural burning) emitted 24% and wastewater management contributed 20%. These 3 main sources are responsible for almost 80% of the total methane emissions in 2011, with landfills, RCI fuel use, and coal mining accounting for most of the remaining emissions. All sources show increases in 2020 BAU projections except for RCI fuel use, coal mining, manure management, and forest fires. Landfill emissions are projected to more than double by 2020, and on road transportation emissions are projected to increase dramatically as well.



Methane reductions aimed at the natural gas and agriculture sectors and better management and utilization of organic waste in the waste stream can result in large reductions of methane emissions. Mitigation strategies would have a significant impact on regional SLCP concentrations. This can be accomplished by diverting the organic material and treating it as a potential resource for renewable fuels and composting. These actions will have a positive impact on Maryland's economy and will create jobs.



A significant effort is needed to evaluate methane emissions from the natural gas industry, the greatest source of methane emissions in Maryland. Renewable sources of process gas should be utilized as much as possible by using capturing it at sources such as landfills, wastewater treatment plants, food waste facilities, and agricultural operations. The oil and gas sector must reduce fugitive methane leaks, a large source of atmospheric methane. Energy demand projections indicate that that consumption of natural gas will increase by 2040, making these steps to control emissions especially important.

Maryland's HFC emissions are also expected to increase by 2020, with some projections indicating that HFC emissions could as much as triple by 2030. Hydrofluorocarbons (HFC) in Maryland are emitted as a result of being substituted for ozone depleting substances, or ODS. HFCs accounted for about 7% of Maryland's total GHG emissions in 2011 using a 20 year global warming potential. Emissions are projected to increase to around 8% of total emissions in 2020 and will significantly increase annually as seen in the figure below.

Alternatives to currently utilized HFCs are commercially available and have lower GWPs. HFCs can also be captured and destroyed from the emission sources with relative ease, especially from appliances that have reached the end of their use. HFCs can be phased out in favor of low

GWP alternatives that have the same function, such as hydrocarbons for domestic refrigeration and NH_3 for industrial refrigeration.

There is limited data available for black carbon emissions in Maryland. This is an area that needs a greater focus.

<u>What are we already doing in Maryland to reduce SLCP emissions?</u>

<u>Methane</u>

Methane is emitted from a variety of sources related to Maryland's agriculture industry, the natural gas sector, and waste generation and processing. Maryland has already taken steps to curb emissions, including requiring controls on landfills and providing incentives to capture and destroy methane emissions from agriculture. In addition, existing source reduction and landfill diversion targets in the state's Zero Waste Plan will further reduce (or eliminate) organic waste disposal in landfills and the resultant methane emissions.

Capturing and utilizing methane from Wastewater Treatment Plants is a burgeoning area of opportunity that Maryland has already begun exploring. Sixty-seven major wastewater treatment facilities in Maryland have been targeted to be upgraded with enhanced nutrient removal (ENR) technologies to reduce nutrients in wastewater effluent and reduce methane emissions. Over 40 plants have already been upgraded as of late-2015. Emissions reduction benefit from these upgrades is currently unknown.

<u>Black carbon</u>

Black carbon emissions are 90% lower than they were in the 1960s, and will be cut in half again by 2020. Maryland has several programs and regulations to reduce diesel particulate emissions, a major source of black carbon emissions:

- Maryland Diesel Vehicle Emissions Control Program
- Engine idling restrictions
- Diesel retrofits
- SmartWay upgrade kits (voluntary fleet fuel efficiency improvements)

EPA Rules

- 2007 Heavy Duty Highway Diesel Rule
- Clean Air Non-Road Diesel Engine & Fuel Rule
- Highway and Non-Road Diesel Rules (updated in April 2006)
- Clean Diesel Program for Locomotives and Marine Engines

HFCs

National actions and international agreements are the current drivers for the control of HFC emissions. The pollutants are being reduced from refrigerants, motor vehicle air-conditioning, and consumer products that together will reduce these potent emissions.