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Memorandum

December 15, 2019

TO: Interested Persons

FROM: Christina Van Winkle, Senior Environmental Analyst, (303) 866-6289

SUBJECT: Greenhouse Gas Emissions Report Overview

Summary

This memorandum provides an overview of the process and methodology for drafting greenhouse gas emissions reports, pursuant to Section 2-2-322.3, C.R.S. At the 2019 legislative session, House Bill 19-1188 was passed and signed by the Governor, which requires Legislative Council Staff to prepare greenhouse gas emissions reports on certain legislative bills starting at the 2020 legislative session.

What is a Greenhouse Gas Emissions Report?

A greenhouse gas emissions report will assess whether a legislative measure is likely to directly cause a net increase or decrease in greenhouse gas pollution within a 10-year time period following enactment. The report will identify new sources of greenhouse gas emissions, changes in existing sources of emissions, and any impact on sequestration of emissions. The report is not required to quantify the magnitude of the impact on emissions.

Report Process

The President of the Senate, the Speaker of the House of Representatives, the Minority Leader of the Senate, and the Minority Leader of the House of Representatives may each request up to five reports during each legislative session. Legislative Council Staff will prepare a report, based on the official version of the bill on the date of the request, within 14 calendar days of the initial request. If a greenhouse gas emissions report is completed while a bill is in the first chamber, the report may be revised for the second chamber if substantive amendments are made. A final report will be published based on the enacted bill, or, if not enacted, the most recent official version of the bill.[1]

[1] Full details about the report process can be found in the December 1, 2019, letter from Legislative Council Staff to the Executive Committee of Legislative Council, available at: http://leg.colorado.gov/publications/procedures-greenhouse-gas-emissions-reports-form

Content and Methodology of Greenhouse Gas Emissions Reports

Greenhouse gas emissions reports will identify and describe the direct impacts that the legislative measure is likely to have on greenhouse gas emissions and sequestration. Typically, the information listed below will be included in each report.

Sectors impacted. For each measure, the emissions sectors potentially impacted by the legislative measure will be identified. The sectors will conform to those used in the most recent Colorado Greenhouse Gas Inventory report prepared by the Colorado Department of Public Health and Environment,[2] which include:

- electric power;
- transportation;
- residential, commercial, and industrial fuel use;
- natural gas and oil systems;
- coal mining and abandoned mines;
- agriculture;
- industrial processes;
- land use, land use change, and forestry; and
- waste management.

Net change. The measure will be assessed for its net impact on greenhouse gas emissions, and will be assigned one of three categories: increase, decrease, or indeterminate. When appropriate, the report will identify when the estimated impact is minimal.

Emissions impact summary. An emissions impact summary will highlight the key findings and overall emissions assessment identified in the report.

Key provisions impacting greenhouse gas emissions. For each measure analyzed, the key provisions that may impact greenhouse gas emissions, or sequestration, will be identified and stated in the report. The key provisions listed are not a comprehensive summary of the bill; instead, they focus only on provisions that potentially impact emissions.

Background. A background section will provide information on the current emissions profile in Colorado, and will draw on the most recent inventory published by the Colorado Department of Public Health and Environment. This section will provide a baseline for total greenhouse emissions, as well as emissions in the sectors potentially impacted by the legislative measure. All emissions are reported in carbon dioxide equivalent based on their global warming potential (see Glossary of Terms). Depending on the nature of the bill and available data, additional background information may be provided for context.

Emissions assessment. The emissions assessment section will identify potential impacts on greenhouse gas emissions or sequestration. In most cases, the report will qualitatively discuss the direction and magnitude of potential emissions impacts. At the discretion of the Director of Research, data and other information may be included in the report to inform and provide context to the qualitative assessment of emissions impacts.

[2] Colorado Department of Public Health and Environment prepares the Greenhouse Gas Inventory reports, which can be found online at: https://www.colorado.gov/pacific/cdphe/colorado-greenhouse-gas-reports.

Data sources and agencies contacted. The report will list any agencies contacted and data sources referenced for the emissions assessment.

Greenhouse Gas Emissions Report Glossary of Terms

This section provides a glossary of terms commonly used in greenhouse gas emissions reports.

Greenhouse Gas. Greenhouse gases (GHG) are the aggregate group of the following six greenhouse gases: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Carbon dioxide equivalent (CO_2e). Carbon dioxide equivalent is the metric used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP, see below). The carbon dioxide equivalent is determined by multiplying the mass amount of emissions (e.g., tons per year) for each greenhouse gas by that gas's GWP, and summing the resultant values to determine CO_2e (e.g. tons per year). This allows for comparison of the global warming impacts of different gases.

Global Warming Potential (GWP). Greenhouse gases warm the earth by absorbing energy that otherwise would have radiated into space. Each gas has a different effect on global warming, based on the gas's ability to absorb energy, and how long the gas remains in the atmosphere (i.e., its lifetime). GWP allows for the comparison of the global warming impacts of different gases by measuring how much energy the emissions of one ton of a greenhouse gas will absorb over a given time period, relative to the emissions of carbon dioxide. Carbon dioxide therefore, as the reference greenhouse gas, has a GWP of 1. Methane, a more potent greenhouse gas than CO_2, has a global warming potential of 25 relative to carbon dioxide over a 100-year time horizon. Thus, when adding greenhouse gas emissions, methane emissions are multiplied by 25. The table below provides the GWPs for the major greenhouse gases.

Table 1
Global Warming Potentials of Greenhouse Gases[3]

Greenhouse Gas	Chemical Formula	Global Warming Potential (100-years)
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous Oxide	N_2O	298
Hydrofluorocarbons	HFCs	varies
Perfluorocarbons	PFCs	varies
Sulfur Hexafluoride	SF_6	22,800

Source: IPCC Fourth Assessment Report.

[3]Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007). See: https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf for full list of GWP values.

Emissions source. Emissions sources are anthropogenic (i.e., human-generated) activities that directly result in greenhouse gas emissions (e.g., the burning of fossil fuels) or indirectly emit greenhouse gases as a result of natural processes that have been affected by human activities (e.g., agricultural soil management).[4]

Carbon sequestration. Carbon sequestration refers to the removal and long-term storage of carbon dioxide from the atmosphere. Biological carbon sequestration occurs when trees, grasses, and other plants take up carbon dioxide through photosynthesis and store carbon in biomass (e.g., tree trunks, foliage, and roots). Geological carbon sequestration is the process of storing carbon dioxide in below ground geological formations, sometimes referred to as "carbon capture and storage."[5] Areas that remove and store carbon are sometimes referred to as carbon "pools" or "sinks."

Emissions sectors. Greenhouse gas emissions reports will analyze the impacts on emissions across a number of sectors, as defined in the Colorado Greenhouse Gas Inventory[6]. Each emissions sector is defined in the table below.

Table 2
Emissions Sectors and Description

Emissions Sector	Description
Electric Power	The electric power sector generates, transmits, and distributes electricity to residential, commercial, and industrial end users.
Transportation	The transportation sector includes combustion emissions from all motorized vehicles for on-highway and off-highway (e.g., boats, aircraft) use of transporting people and/or goods.
Residential, Commercial, and Industrial Fuel Use	Fuel use includes the combustion of fuels in residential, commercial, and industrial sectors for heating and various commercial purposes. Industrial fuel use also includes fossil fuels used for non-combustion purposes, such as in the production of lubricants, solvents, and as feedstocks for asphalt and road oil.
Natural Gas and Oil Systems	The natural gas and oil systems sector includes the extraction, processing, transportation, and distribution of natural gas and oil.
Coal Mining and Abandoned Mines	The mining sector includes active and abandoned surface and underground coal mines, as well as the processing, transportation, and storage of coal.
Agriculture	The agriculture sector includes emissions from livestock and crop production activities, including enteric fermentation, manure management, agricultural soil management, and agricultural residue burning.
Industrial Processes	Industrial processes include the manufacturing of products such as steel, cement, aluminum, lime, soda ash, and nitric acid. Greenhouse gases are emitted as byproducts of non-energy related industrial activities, or due to their use in manufacturing processes or by end-consumers.

[4]IPCC Guidelines for National Greenhouse Gas Inventories (2006). See: https://www.ipcc-nggip.iges.or.jp/public/2006gl/.
[5]United States Geological Survey. See: https://www.usgs.gov/faqs/what-carbon-sequestration?qt-news_science_products=0#qt-news_science_products
[6] The Colorado Greenhouse Gas Inventory, developed by the Colorado Department of Public Health and Environment, utilizes the U.S. Environmental Protection Agency's State Inventory Tool modules, developed for the individual emissions sectors identified above. These emissions sectors align with the source categories defined in the IPCC Guidelines for National Greenhouse Gas Inventories.

Table 2
Emissions Sectors and Description (Cont.)

Emissions Sector	Description
Land Use, Land Use Change, and Forestry	This sector accounts for the greenhouse gas fluxes (e.g., net emissions or sequestration of carbon) from land use and land use change within and between all land-use types including forest land, cropland, grassland, wetlands, and settlements.
Waste Management	Waste management includes municipal solid waste and industrial waste that is landfilled or combusted, as well as the industrial treatment of wastewater.

Source: Compiled by Legislative Council Staff from EPA's State Inventory Tool and CDPHE's Greenhouse Gas Inventory Report.

Emissions factor. An emissions factor is the average emissions rate of a given greenhouse gas for a given source, relative to units of activity. For example, greenhouse gas emissions from electric power production are based on the fuel-specific (e.g., coal, natural gas, etc.) carbon content per British thermal unit (Btu), a measure of the heat content of fuels. By multiplying fuel consumption (e.g., Btu) by its emissions factor (e.g., pounds of carbon per Btu), greenhouse gas emissions can be quantified.