

Appendix A Review of Greenhouse Gas Emissions Inventory Protocols

Guidance and Protocol Documents Reviewed

1.1 World Resources Institute/World Business Council on Sustainable Development GHG Protocol

The GHG Protocol Initiative (<http://www.ghgprotocol.org/>) is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission was to develop internationally accepted GHG accounting and reporting standards for businesses and to promote their broad adoption.

Overall, the standard provides guidance for companies and other types of organizations preparing a GHG emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol - carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆). The standard serves the following purposes:

- To help companies prepare a GHG inventory that represents a true and fair account of their emissions, through the use of standardized approaches and principles;
- To simplify and reduce the costs of compiling a GHG inventory;
- To provide businesses with information that can be used to build an effective strategy to manage and reduce GHG emissions;
- To provide information that facilitates participation in voluntary and mandatory GHG programs; and
- To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

Both businesses and other stakeholders benefit from converging on a common standard. For businesses, it reduces costs if their GHG inventory is capable of meeting different internal and external information requirements. For others, it improves the consistency, transparency, and understandability of reported information, making it easier to track and compare progress over time. However, since this Protocol has been developed by and for businesses, it is not appropriate to use at the local government scale.

1.2 International Organization for Standardization (ISO) Protocols

The International Organization for Standardization (ISO) 14064 standards for GHG accounting and verification were completed and published on March 2006. The standards provide government and industries with an integrated set of tools for accounting, verification, and developing programs aimed at reducing GHG emissions and emissions trading. The ISO

14064 is a result of several years of detailed study and engagement with the international community of governmental and business organizations with a stake in climate change.

The development of ISO 14064 was launched in 2002 as a solution to the problems posed by the fact that governments, business corporations and voluntary initiatives were using a number of approaches to account for organization- and project-level GHG emissions and reductions with no generally accepted validation or verification protocols. The goal of the standards is to provide a set of unambiguous and verifiable requirements or specifications to support organizations and proponents of GHG emission reduction projects.

In order to produce an accounting and verification tool that would have broad international backing, ISO embarked on three years of detailed study and engagement with the international community of governmental and business organizations with a stake in climate change. ISO 14064 has resulted from the work of some 175 international experts from 45 countries and 11 international business, development or environmental organizations, and eight international meetings.

Implementing ISO 14064 is intended to achieve the following benefits:

- promote consistency, transparency and credibility in GHG quantification, monitoring, reporting and verification;
- enable organizations to identify and manage GHG-related liabilities, assets and risks;
- facilitate the trade of GHG allowances or credits, and
- support the design, development and implementation of comparable and consistent GHG schemes or programs.

ISO 14064 comprises three standards, respectively detailing specifications and guidance for the organizational and project levels, and for validation and verification. They can be used independently, or as an integrated set of tools to meet the varied needs of GHG accounting and verification. This protocol is primarily used by international corporations and businesses to inventory their GHG emissions and is not appropriate for local government operations.



Source: International Organization for Standards

1.3 The New Jersey Department of Environmental Protection Division of Air Quality Guidance Document 2010 Emission Statement

The guidance document provided by New Jersey is in response to the Federal Clean Air Act which requires states with designated ozone non-attainment areas to gather Emission Statement data from sources of volatile organic compounds (VOC) and oxides of nitrogen (NO_x) beginning in 1992 (reporting in 1993). These two air contaminants react in the presence of sunlight to form ozone in the lower atmosphere, the troposphere, where it affects human health. Carbon monoxide by itself affects human health and elevated levels tend to occur primarily in the winter months. The U.S. EPA requires the State of New Jersey to report the emissions from major sources annually. The Act also requires the state to periodically compile and report a comprehensive, accurate, and current inventory of all air contaminant sources in the state.

The New Jersey Emission Statement rule (N.J.A.C. 7:27-21) establishes requirements for the annual reporting of air contaminant emissions from stationary sources allowing the state to meet these requirements. The air contaminants required to be reported in the Emission Statement rule are carbon monoxide (CO), sulfur dioxide (SO₂), ammonia (NH₃), total suspended particulate matter (TSP), respirable particulate matter (PM₁₀ and PM_{2.5}), lead (Pb), volatile organic compounds (VOC), oxides of nitrogen (NO_x), carbon dioxide (CO₂), methane (CH₄) and the 36 toxic air pollutants (TAP's).

Emission Statements are intended to help the state agencies in their reporting and analysis of emissions into the outdoor air. All emission estimates reported on Emission Statements are used in tracking the state's progress toward meeting the mandatory emission reduction targets specified as a percentage reduction from the 1990 base year inventory. This tracking will assist in monitoring progress towards attainment of the ozone and carbon monoxide National Ambient Air Quality Standard and will be used as an indicator to measure the state's progress in maintaining a healthy environment.

Overall, the guidance provides the most up to date requirements and protocols for calculating emissions for designated facilities. These designated facilities are listed in the guidance as major utility providers, natural gas facilities, and other stationary facilities that meet Emission Statement rule guidelines. Monmouth County does meet the guidelines through its land fill site and reports to NJDEP.

2.0 Protocols for Local Government Operations

As mentioned in Section 1 some guidance and protocols are specific to certain sectors and industries. This section of the report focuses exclusively on local government operating



protocols. This narrows the field of GHG inventory protocols down to ones providing detailed instructions for conducting a local or county level GHG inventory.

2.1 The ICLEI International Local Government GHG Emissions Analysis Protocol (IEAP)

Founded in 1990, ICLEI – Local Governments for Sustainability is an association of city and county governments dedicated to improving global environmental conditions through cumulative local action. Through its campaigns, ICLEI generates political awareness of key environmental issues, provides technical assistance and training to build capacity in local governments to address these issues and evaluates their progress toward sustainable development.

ICLEI created the International Local Government GHG Emissions Analysis Protocol (IEAP) to provide an easily implemented set of guidelines to assist local governments in quantifying the greenhouse gas emissions from both their internal operations and from the whole communities with their geopolitical boundaries. By developing common conventions and a standardized approach, ICLEI seeks to make it easier for local governments to achieve tangible reductions in GHG emissions. The standardized approach described in this protocol facilitates comparisons between local governments and the aggregation and reporting of results being achieved by the action of diverse communities.

While the IEAP has been developed for use by local governments, other parties needing to compile sub-national inventories will find it useful. The protocol has been designed to provide both guidance and establish a standard for local government GHG management programs. At this stage of the Protocol's development, it is intended that local governments will self-identify compliance with IEAP. An accreditation process and associated recognition may be established by ICLEI in the future, for those parties seeking more formal acknowledgment that their greenhouse management is compliant with the International Local Government GHG Emissions and Analysis Protocol.

Users of this protocol, for inventory compilation and reporting purposes, are requested to state that the information presented complies with the requirements of the IEAP. The term “shall” is used in the chapters containing standards to clarify what is required to prepare and report a GHG inventory in accordance with the International Local Government GHG Emissions Analysis Protocol. This is intended to improve the consistency with which the standard is applied and the resulting information that is publicly reported.

A review of available guidance documents reveals that ICLEI's Local Government Operations Protocol (LGOP) is a comprehensive local government-specific greenhouse gas emissions protocol used in the United States. The LGO Protocol is a supplement to the IEAP and was developed by ICLEI USA, The Climate Registry, the California Climate Action Registry, and the California Air Resources Board in 2008 for U.S. local governments.

The LGOP is a program-neutral GHG protocol that is designed to allow local governments in the United States to quantify and report GHG emissions resulting from their operations. It provides



specific calculation methodologies and emissions factors to use in estimating emissions. The LGO Protocol is the most comprehensive and widely-used protocol in the United States for the quantification of GHG emissions from government operations.

The main body of the text of the LGOP (Parts 1 – 4) is “program-neutral,” meaning it outlines the appropriate actions for conducting a GHG inventory without specifying a particular, singular approach, and contains guidance on measuring emissions from buildings, vehicle fleets, wastewater, solid waste, and other sources.

A typical emissions calculation appears as:

{ activity data * emissions factor = quantity of carbon dioxide equivalent }

1. For buildings, emissions are determined based on direct fuel used (such as fuel oil and natural gas) for heating and cooling, as well as indirect emissions from electricity consumption.
2. For vehicles, the transit fleet, and employee commute, emissions are calculated based on total quantity of fuel used and/or vehicle miles traveled.
3. Wastewater treatment is not a sector all local governments have. If present, wastewater treatment emissions are estimated based on treatment technologies and quantity of water treated.
4. Solid waste emissions are based on either waste disposed of by a local government or waste deposited in a local government-owned landfill. For waste disposed of, the calculation is based on tonnage, for landfills, methods depend on methane controls present at the landfill site.

Based on a review of available guidance documents, ICLEI’s Local Government Operations Protocol is the only comprehensive local government-specific greenhouse gas emissions protocol in the United States. As such, the Berger Team recommends that Monmouth County use the LGO Protocol for its inventory of County facilities.

3.0 Software Calculation Tools For Transportation Related GHG Inventories

While GHG inventory protocols standardize the methodologies for conducting GHG inventories, calculating GHG emissions can be a multi-step process that may include utilizing a variety of tools including software applications, excel workbooks, modeling tools, and on-line tools. This section evaluates a variety of tools that can be used to calculate GHG emissions.

3.1 CACP (Clean Air and Climate Protection) 2009 Software

CACP 2009 was developed specifically to support emissions inventories based on the principles and methods of the ICLEI Local Government Operations Protocol. It serves as a one-stop



emissions management tool that calculates and tracks emissions and reductions of GHG and criteria air pollutants associated with electricity consumption, fuel use, waste disposal and other processes.

ICLEI has provided local governments in the United States with software for the quantification of GHG since the mid-1990s. CACP 2009 was developed specifically to support emissions inventories based on the principles and methods of the LGO Protocol. At present, 600 ICLEI members in the United States use CACP 2009 to develop their government operations and community inventories, set reduction targets, and develop climate action plans.

CACP 2009 provides the following:

- Create emissions inventories for the community as a whole or for the government's internal operations.
- Quantify the effect of existing and proposed emissions reduction measures.
- Predict future emissions levels.
- Set reduction targets and track progress towards meeting those goals.

Monmouth County is already using CACP 2009 to complete the facilities portion of its operations inventory, making use of CACP 2009 for the vehicle fleet portion of the inventory a natural fit. The Berger Team recommends that Monmouth County use the CACP 2009 Software for its inventory of government operations.

3.2 EPA MOVES2010 (Motor Vehicle Emission Simulator) Model

MOVES2010 is the state-of-the-art upgrade to EPA's modeling tools for estimating emissions from highway vehicles, based on analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions. The MOVES2010 model is the upgraded version of EPA's MOVES6 and MOVES 6.2 models mentioned in Section 5.

MOVES2010 can be used to estimate air pollution emissions from cars, trucks, motorcycles, and buses. The EPA has approved the model for use in official state implementation plan (SIP) submissions to EPA and for transportation conformity analyses outside of California. It can also be used to estimate the benefits from a range of mobile source control strategies, for more general analyses of national or local emissions trends, and for policy evaluation. MOVES2010 is EPA's best available tool for quantifying criteria pollutant and precursor emissions, as well as for other emissions analyses of the transportation sector.

State and local agencies estimating GHG emissions in the transportation planning process should consider using MOVES2010 for GHG emissions analyses in the future. Regarding transportation conformity, EPA and DOT intend to establish a two-year grace period before MOVES2010 is required for new transportation conformity analyses outside of California.

A separate guidance document, "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes," addresses



general policy issues for MOVES such as timing of the use of MOVES in SIPs and conformity analyses.

The NJTPA is also using the MOVES2010 model in their regional GHG emission inventory. The model is primarily used to calculate emissions factors for the various modes of traffic, autos, heavy and light trucks, so on, in the region.

3.3 G.R.E.E.T.

The GREET model (Greenhouse gases, Regulated Emissions, and Energy use in Transportation), was created by the U.S. Argonne Laboratory for the Department of Energy. The first version of GREET was released in 1996. Since then, Argonne has continued to update and expand the model. The most recent GREET versions are GREET 1.8c.0 version for fuel-cycle analysis and GREET 2.7 version for vehicle-cycle analysis. The models are based on Microsoft Excel and Visual Basic and have 100 fuel production pathways and more than 70 vehicle/fuel systems¹ in the model. The model can separately calculate for a given vehicle and fuel system:

- Consumption of total energy (energy in non-renewable and renewable sources), fossil fuels (petroleum, natural gas, and coal together), petroleum, coal and natural gas.
- Emissions of CO₂-equivalent greenhouse gases - primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).
- Emissions of six criteria pollutants: volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxide (NO_x), particulate matter with size smaller than 10 micron (PM₁₀), particulate matter with size smaller than 2.5 micron (PM_{2.5}), and sulfur oxides (SO_x).

The GREET model measures the GHG emissions of a transportation's mode throughout its entire life cycle. The model is designed to measure the hidden environmental costs or unforeseen consequences of fuel and technology changes in a vehicle fleet that uses a variety of different fuels. The GREET model is intended to be used by fleet managers to generate petroleum use and GHG emissions on a well-to-wheels (WTW) basis. A WTW analysis can be divided into two stages: well-to-pump (WTP) and pump-to-wheels (PTW). The WTP stage starts with the fuel feedstock recovery, followed by fuel production, and ends with the fuel available at the pump, while the PTW stage represents the vehicle's operation activities. The model examines transportation fuels and technologies on a WTW basis in order to properly compare alternatives, as activities upstream of vehicle operation can use significant amounts of energy and subsequently produce a large amount of emissions.

The GREET model was used in the NJTPA methodology to assess the life cycle consumption for the region's transportation GHG emissions. The County will not need the GREET model unless the County changes its fleet from conventional technology and fuels to alternative technologies

¹ Some systems includes are: Conventional spark-ignition engines, Direct-injection, spark-ignition engines, Direct injection, compression-ignition engines, Grid-independent hybrid electric vehicles, Grid-connected (or plug-in) hybrid electric vehicles, Battery-powered electric vehicles, and Fuel-cell vehicles



and fuels. For instance, if the County introduces an increased presence of bio-diesel or ethanol mix fueled vehicles the GREET model would be used to measure the impact of those changes.

4.0 Other Software Calculation Tools For GHG Emissions

Apart from tools that measure GHG emissions in the transportation sector, there are a variety of tools that measure emissions across other areas, including the built environment. Other tools also exist to calculate emissions across multiple sectors, using a web-based platform. This section profiles GHG measurement tools that extend beyond exclusively transportation.

4.1 Remote AIMS Data Input User System (R.A.D.I.U.S.)

The Radius software is used by NJDEP's Air Quality Permitting Program. RADIUS stands for **Remote AIMS Data Input User System** which enables an entity to electronically prepare and submit pre-construction and operating permit applications for NJDEP. These submissions are loaded into the New Jersey Environmental Management System (NJEMS). The NJDEP uses NJEMS to process inputs from all stationary air-regulated industries in the state.

This information is used to gather GHG emissions for the state's mandatory recording program that is mandated by the federal Clean Air Act. Only facilities that qualify for measurement, based on the U.S. EPA Greenhouse Gas Reporting Rule that requires facilities that emit 25,000 metric tons or more per year of GHG emissions to submit annual reports to EPA, should use this software. Facilities such as power plants and land fill sites may be required to use this application to track their emissions. Currently the County is required to use R.A.D.I.U.S to track emissions from the Monmouth County Reclamation Center.²

Although this program is not intended for general local government use, this report includes a description of RADIUS to inform policy makers on the differences in calculation tools being utilized by New Jersey.

4.2 EnergyStar Portfolio Manager

EnergyStar's Portfolio Manager is an interactive energy management tool that allows for tracking and assessing energy and water consumption across an entire portfolio of buildings online. The software is designed to set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance. Users create an account to store their energy consumption and cost data, benchmark building energy performance, assess energy management goals over time, and identify strategic opportunities for savings and recognition opportunities.

² Kevin Ganson, MCRC Assistant Superintendent



The tool also allows streamlining of a portfolio's energy and water data, and tracking key consumption, performance, and cost information portfolio-wide. The tool can:

- Track multiple energy and water meters for each facility;
- Customize meter names and key information;
- Benchmark your facilities relative to their past performance;
- View percent improvement in weather-normalized source energy;
- Monitor energy and water costs;
- Share your building data with others inside or outside of your organization; and
- Enter operating characteristics, tailored to each space use category within your building.
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The methodology for calculating GHG emissions in the tool was designed to be consistent with the GHG Protocol developed by the World Resources Institute and World Business Council for Sustainable Development, and is compatible with the accounting, inventory and reporting requirements of EPA's Climate Leaders program, as well as other state and NGO registry and reporting programs.

Many property managers, energy managers, and sustainability staff use Portfolio Manager in conjunction with other GHG emissions management tools. Portfolio Manager focuses exclusively on building performance, so it cannot develop a comprehensive inventory, but the ability to obtain an ENERGY STAR label is a valuable and compelling feature which leads many to use it in addition to their primary GHG management system. EnergyStar Portfolio Manager is used for assessing the GHG emissions of the built environment, and therefore not suitable for measuring transportation emissions.

4.3 CARROT Software

The Climate Action Registry Reporting Online Tool (CARROT) is the California Registry's GHG emission calculation and reporting software. The California Registry has developed this unique, web-based tool as the online companion to the Registry's protocols. All GHG emissions data is entered and managed via CARROT. It is used by California Registry members, verifiers, and the public.

CARROT uses built-in emission factors and conversion factors to automate calculation of GHG inventories and improve consistency and comparability. Users input annual energy usage data (i.e. kWh of electricity, or MMBtu of natural gas) and CARROT calculates the associated GHG emissions. Since CARROT includes built-in emissions factors and conversion factors that are unique to California, it is not appropriate to use outside of California.

