

# How are WRRFs inventorying greenhouse gas emissions?

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## Introduction

Water resource recovery facilities (WRRF) across the United States are beginning to adopt policies and goals to reduce and offset their greenhouse gas (GHG) emissions. In turn, these utilities are performing GHG emission inventories to determine their baseline emission levels and gain insight into the best way to optimize WRRF operations in order to minimize their carbon footprint. In an effort to inform utilities that are considering performing GHG emissions inventories, the Water Environment Federation's (WEF) GHG Subcommittee surveyed nine WRRFs of varying size and geographical location with experience performing GHG inventories and summarized their responses in this fact sheet.

## What is a GHG inventory?

A GHG inventory is an accounting of both GHG emissions and offsets related to a person, organization, or process over a period of a time. The accounting begins with setting a system boundary. For a WRRF, this includes the operations, chemicals, and transport necessary for the treatment of wastewater, the collection system, and associated pump stations (if they are owned and operated by the WRRF); it may include buildings (e.g., administrative and laboratory buildings) associated with WRRF operations.

WRRFs can also offset GHG emissions by recovering resources, such as biogas and biosolids, and beneficially using them. For example, biogas from anaerobic digesters can be used for the production of electricity or to replace natural gas in the grid or for vehicle fueling. Biosolids can be [land applied](#) to avoid the use of energy-intensive synthetic fertilizer and to sequester carbon in the soil.

GHG emissions and offsets are categorized into Scope 1, 2, and 3 emissions, as described in Figure 1.

Scope 1	Scope 2	Scope 3
<ul style="list-style-type: none"> <li>Direct emissions from combustion of fuels by stationary sources and vehicle fleets owned by the utility and direct emissions from treatment processes.</li> </ul>	<ul style="list-style-type: none"> <li>Indirect emissions from the use of purchased electricity, steam, heating, or cooling; whereby the fuel combustion (emissions) occurs off-site.</li> </ul>	<ul style="list-style-type: none"> <li>Indirect emissions related to material consumption (chemical production and transport, replacement materials) and transport of grit/screenings and biosolids to an end use, and beneficial use of recovered resources (emission offsets).</li> </ul>

Figure 1. Sources of GHG emissions are categorized as Scope 1, 2, or 3

A questionnaire was provided to the nine utilities and the following is a documentation of findings.

## 1. Why are WRRFs inventorying GHG emissions?

Wastewater utilities inventory GHG emissions for various reasons: WRRF-specific sustainability considerations; to support city, state, or regional goals; to comply with regulatory requirements; and/or to obtain financial incentives. Figure 2 shows the number of responses to the question, "What are the major drivers for performing GHG inventories?" The leading drivers for those surveyed are WRRF-specific sustainability considerations (such as internal

energy, climate and resource recovery goals) and regulations.

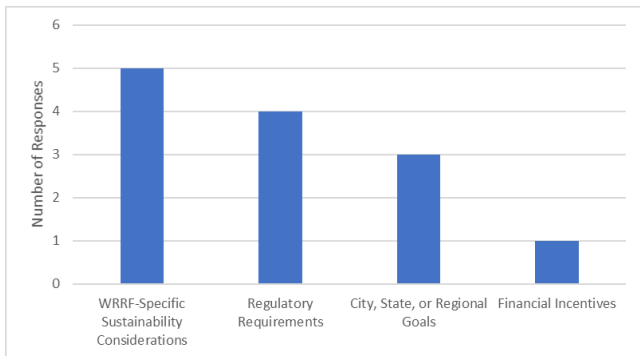


Figure 2. WRRF responses to “What are the drivers for performing a GHG inventory?”<sup>1</sup>

## 2. How are WRRFs performing their GHG inventories?

Four sub-questions were included in the survey to answer this question:

### a) Who is performing the GHG inventory?

GHG inventories may be performed by WRRF staff, by a third party (e.g., consultants or other organizations) through a contract or by a combination of WRRF and third-party staff. Figure 3 shows the distribution of survey responses.



Figure 3. WRRF responses to “Who is performing the GHG inventory?”

### b) What tools and methodologies are used?

Several tools and methodologies are publicly available and needed for performing a WRRF GHG inventory. Most WRRF staff and third-party contractors

use Microsoft Excel-based tools; while some use web-based platforms for reporting. The WRRFs surveyed cited several methodologies, including:

- [Local Government Operations Protocol \(LGOP\)](#): developed in partnership with the California Air Resources Board (CARB), the Climate Action Reserve (CAR), the California Climate Registry (CCAR, which is now The Climate Registry), and [ICLEI – Local Governments for Sustainability](#).
- [Greenhouse Gas \(GHG\) Protocol](#): developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).
- Custom methodologies developed for the Intergovernmental Panel on Climate Change (IPCC), [The Climate Registry \(TCR\)](#), [EPA's Inventory of U.S. GHG Emissions and Sinks](#), [EPA's Emissions & Generation Resource Integrated Database \(eGRID\)](#), and published research.

### c) What is included in the system boundary?

The system boundary may include Scopes 1, 2, and 3 emissions and offsets, as described in Figure 1. All of the utilities surveyed included Scope 1 and 2 emissions, and about half included Scope 3 emissions, as shown in Figure 4.

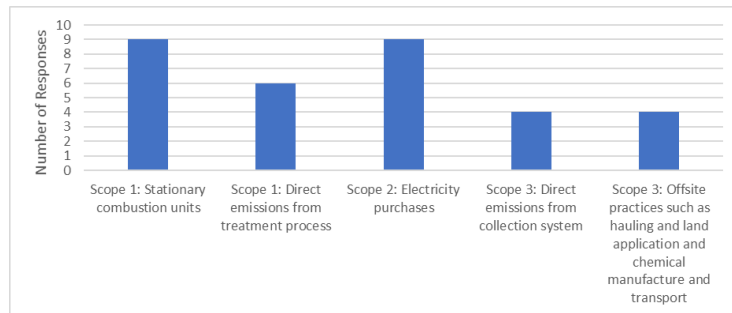


Figure 4. WRRF responses to “What sources are included in a GHG inventory?”<sup>2</sup>

### How are the results used?

Of the nine utilities surveyed, there is a roughly even split between those who use the GHG inventory results as a benchmark (five) or as a guide in decision-making (four). In addition, one utility's GHG emissions inventory results were generated to support their efforts in applying for [grant funding](#).

<sup>1</sup> The number of responses sums to more than nine since those WRRFs that responded to the survey had multiple drivers.

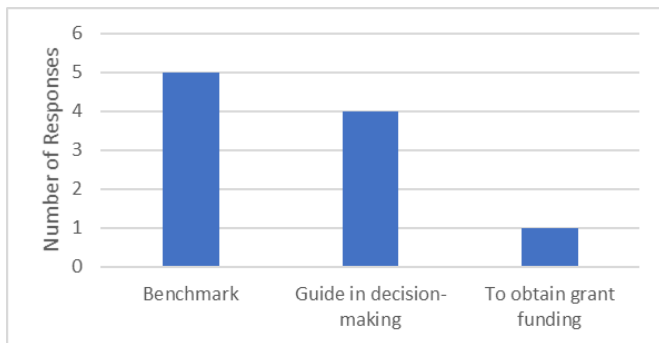


Figure 5. WRRF responses to “How are the results used?”<sup>2</sup>

### 3. What are the challenges of developing GHG inventories?

The major challenges identified for developing GHG inventories were associated with data collection, methodologies, emission factors, and cost. Specific challenges associated with each are as follows:

- Data collection.** GHG inventoring entails collecting data for each source which may be recorded and or filed in different locations and in varying formats (e.g., electronic spreadsheets, handwritten records, word processor documents, reports of varying time scales, different units of measure) or have varying lag times between when the data is collected and when it is ready for use in analyses (following quality assurance and quality control measures). Furthermore, some data needed for GHG inventories is simply not collected since it is not information that is needed for any other reporting purposes. For example, several WRRFs use small amounts of refrigerants, which are GHGs with a very high global warming potential (GWP), but they have not tracked use levels. Data collection for Scope 3 emissions can be particularly difficult since those sources of emissions and offsets are associated with actions performed outside the fence line of the WRRF (i.e., collecting fuel and chemical usage data from third parties can be challenging).
- Inconsistent use of methodologies.** The tools and methodologies used by an organization may be altered over time, making it difficult to track progress relative to the baseline emissions inventory. Additionally, different organizations use different methodologies that represent the best

fit and need they are seeking to fulfill, making it difficult to benchmark against each other.

- Unavailable or unreliable emission factors.** Various emission factors associated with specific WRRF treatment processes and biosolids end uses are either outdated or have not been incorporated into existing published protocols. Research is underway in each of these areas that can inform updates to the emission factors.
- Cost.** Costs can range from as low as a few hours of staff time or \$10,000 for a one-time snapshot, all the way to \$200,000 spread over a year. Cost depends on the level of detail, complexity, and system boundary of the inventory, the quality of the existing data, and whether an existing tool is used or a new tool needs to be developed.

### The future of GHG inventoring at WRRFs

As regulatory requirements become more stringent, more financial incentives become available, and as WRRFs strive for improved sustainability by reducing and offsetting their GHG emissions, it is expected that an increasing number of WRRFs will perform GHG inventories. For these efforts to be cost-effective, and for the results to be useful, the following recommendations are listed below based on survey responses:

- Automate data collection.** Proper metering and data retention are critical. GHG inventories are only as accurate as the data that is used to produce them. Ensure data needed (including units of measure, time scale, frequency of measure, etc.) for GHG inventoring is being collected across the various departments or divisions of your organization. Typically, data will be needed on energy usage, nitrogen removal, fleet fuel usage, biosolids and chemical hauling, and process flows.
- Streamline inventory template.** Determine whether your organization will use a spreadsheet or other tool that is formatted for easily linking plant data to the GHG inventory calculations.
- Standardize methodologies.** Don't reinvent the wheel. Use an existing tool based on established GHG accounting protocol methodologies. Some WRRFs are willing to share their tools for reference. Standardizing tools and methodologies will make it easier to compare one WRRF's results to other similar WRRFs for industry benchmarking. Several wastewater treatment process modelling simulators now incorporate frameworks for estimating GHG emissions based on plant configuration and operating conditions. Process models could play an

important role in estimating and optimizing GHG emissions.

- **Establish a regular inventory schedule.** Many utilities recommend a minimum reporting period of once a month (for data collection and retention purposes), which is standard for mandatory reporting programs. Tracking changes over time allows utilities to identify areas of focus and to see whether GHG reduction initiatives are making an impact.

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## Further Reading

- [Introduction to Funding Opportunities: Bioenergy and GHG Reducing Projects](#)
- [FAQ: Land Application and Composting of Biosolids](#)
- [Introduction to Bioenergy Funding through Public Private Partnerships](#)
- [High Performance Anaerobic Digestion](#)

## Additional Resources

- Biogas Data:  
<http://www.resourcerecoverydata.org/>
- [Water Environment Federation](#)

## Contact

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