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Creation and Third-party Verification of Large Governmental Greenhouse Gas Emission Report

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ABSTRACT

The changing climate impacts society and the ecosystem in many ways including disastrous frequency, public health, energy supplies, and more. As the state's public policies become more stringent with climate policy, local governments are mandated to report their greenhouse gases (GHG) emissions and to make plans for measurable GHG reductions in subsequent years. Among the top five populous counties in the United States*, the County of San Diego (CoSD) oversees over 1000 facilities, consuming over 100 GWh annually. In the processes of creating an organizational greenhouse gas (GHG) emissions inventory report using the Climate Registry Information System (CRIS), the CoSD encountered many complications in the data collection and reporting requirements. From obtaining third-party verification to validating results, this article presents an insight on understanding obstacles and leverages to achieve a high level of confidence in reporting for large governmental bodies.

*U.S. Census Bureau. (2011). [Data Online]. 12 February 2014. http://www.census.gov/popest/data/counties/totals/2011/tables/CO-EST2011-07.csv

INTRODUCTION

The project for the creation and third-body verification of the greenhouse gas emission report continually ran into problems as it was being produced. Since we predict that in the future all governmental bodies may have to report their own greenhouse gas emissions, we want to provide our recommendations and strategic approaches for large governmental bodies or even large corporations to do that. To begin, we shall provide a background of the reasons the CoSD became involved as well as quickly introduce ourselves and the organizations that were involved. Furthermore, we will address the details from the creation and data collection process relevant to the success of the inventory report. Lastly, we will discuss the criteria of selecting a verification body and the challenges in obtaining a high level of confidence, leading to the dialogue of future reporting standards.

Climate Action Plan

The Climate Action Plan (CAP) was adopted in June of 2012 to establish GHG emissions reduction goals. The benefits of following this plan are introduced at the end of this section. To begin, the following are highlights from the GHG emissions reduction goals [1]:

- Mitigate the impacts of climate change by achieving meaningful GHG reductions within the county, consistent with Assembly Bill (AB) 32, the governor's Executive Order S-3-05, and California Environmental Quality Act (CEQA) guidelines.
- Allow lead agencies to adopt a plan or program that addresses the cumulative impacts of a project.
- Provide a mechanism that subsequent projects may use as a means to address GHG impacts under CEQA, in accordance with the 2011 statement by the Attorney General.

As prescribed by the CAP, all emissions from CoSD operations must be recorded following the methodologies established by the Local Government Operations Protocol (LGOP). CoSD GHG reports were created for the baseline year of 2006 and for the years 2010, 2011, and 2012. The 2010 report was selected by CoSD staff for verification by an approved third party of The Climate Registry (TCR). This record of

emissions can then be compared to the goals set by the CAP to confirm that they are satisfied.

In compliance with Assembly Bill (AB) 32 and Executive Order S-3-05 of the State of California, the CoSD CAP established operational emissions reductions at 15% below the calculated 2006 baseline [1]. The 2006 baseline calculation categorized operational emissions into 9 sectors for the purpose of creating an inventory and reporting present and future emissions. However, through the process of third-party verification, it was revealed that this baseline does not identify all of CoSD's emissions required for reporting. Therefore, these reports may change, if applicable. This is further discussed throughout this article.

See Figure 1 for relevant State of California legislation and policies.

Bill & Date of Issuance	Title	Implementing Agency
Executive Order S-3-05 (2005)	Greenhouse Gas Initiative	California Air Resource Board (ARB)
Assembly Bill (AB) 32 (2006)	Global Warming Solutions Act	ARB
Senate Bill (SB) 97 (2007)	CEQA Guideline Amendments	California Office of Planning and Research (OPR)
SB 375 (2008)	Sustainable Communities and Climate Protection Act	Metropolitan planning and organizations (MPO)
AB 1493 (2002)	Pavley	ARB
Executive Order S-1-07 (2007)	The Low Carbon Fuel Standard (LCFS)	ARB
SB X-1-2 (2011)	Renewable Portfolio Standard	California Public Utilities Commission
SB 7X 7 (2009	State Water Conservation	Department of Water Resources
CCR Subarticle 1 € 95300 (2009)	Heavy Duty Vehicle Greenhouse Gas Emission Reduction Measure	ARB

Figure 1. California Climate Change Legislation and Policy. Source: CoSD Climate Action Plan [1]

In addition to emissions reduction goals, the CoSD CAP suggests measures for implementing reduction actions by sector. Implementation

of the following strategies will theoretically attain emissions reductions of at least 15% below the 2006 baseline:

- Reduce energy consumption in existing facilities by 1% per square foot per year;
- Achieve energy efficiency in new construction to exceed Title 24 Building Standards;
- Provide energy from renewable sources that equals at least 2% of the county's total annual electricity usage by 2012;
- Institute utility monitoring and reporting at CoSD facilities; and
- Achieve increased fleet fuel efficiency of 5% by 2013 and 1% increase per year from 2014-2020.

The CAP also created projected emissions for 2020, 2035, and 2050 as shown in Figure 2. A benefit in complying with the CAP is the Cap and Trade regulation. The State of California implemented a Cap and Trade regulation on January 1, 2012 to provide incentives to achieve AB 32 targets [2]. This market-based regulation sets industry emissions limits (through caps) as well as financial incentives for companies to operate within these limits. Organizations that exceed the caps can offset these emissions by purchasing carbon credits from companies that stay below limits. This regulation establishes a market for selling or trading of carbon permits. Additionally, the cap is expected to decline approximately 3% each year beginning in 2013 [3]. With this decrease in GHG emissions limits, carbon credits will become more valuable in the future. This market will provide financial incentives for the County of San Diego to reduce GHG emissions when it becomes part of this regulation. Participation in the Cap and Trade market will require precise GHG emissions inventories, which is why CoSD has scrutinized operational emissions calculations through third-party verification. Moreover, another incentive to quantify GHG emissions can influence decisions makers to adopt measures that would lessen the burden on the environment as well as inducing long-term economic savings.

CoSD Background

The County of San Diego operates from over 1000 facilities located throughout the county, as illustrated by Figure 3. All emissions

TABLE 2.4 | COUNTY GOVERNMENT GHG BASELINE AND PROJECTED EMISSIONS

SECTOR	2006	BAU 2020	BAU 2035	BAU 2050
	MT CO_2E			
Solid Waste Facilities	64,192	48,516	35,943	26,627
Employee Commute	57,572	63,017	70,776	73,893
Buildings and Facilities	55,291	61,420	67,987	75,256
Vehicle Fleet	23,231	24,960	27,428	28,611
Wastewater Facilities	11,656	13,451	16,232	17,661
Government-Generated Solid Waste	4,892	5,256	5,776	6,025
Public Lighting	2,160	2,493	3,008	3,273
Airport Facilities	1,153	1,331	1,606	1,747
Water	488	524	576	601
Total[1]	220,633	220,968	229,331	233,695

[1] Because of rounding, the total does not equal the sum of sectors.

Figure 2. 2006 Baseline and Projected Emissions in Nine Categories from the CoSD CAP [1]

produced by these sites need to be accounted for in the GHG report. The total amount of energy consumed by these sites in 2012 exceeds 100 GWh of electricity and 2 million therms of natural gas. Based on the energy usage per capital, CoSD trends show similar consumption rate comparative of the State of California, which averages to be 6,721 kWh in 2009. [4,5]

The Climate Registry

The report complies with The Climate Registry, which is a non-profit collaboration among North American governments that sets consistent and transparent standards to calculate, verify and publicly report greenhouse gas emissions into a single registry. The Climate Registry (TCR) is responsible for setting standards for creating the inventory for GHG emissions (LGOP), facilitating verification, and establishing and maintaining the Climate Registry Information System (CRIS), a web-based tool for registering data. This tool, which allows the user to submit raw data such as energy usage of a facility, was used by CoSD to calculate and report operational GHG emissions. [6] CoSD chose to hire

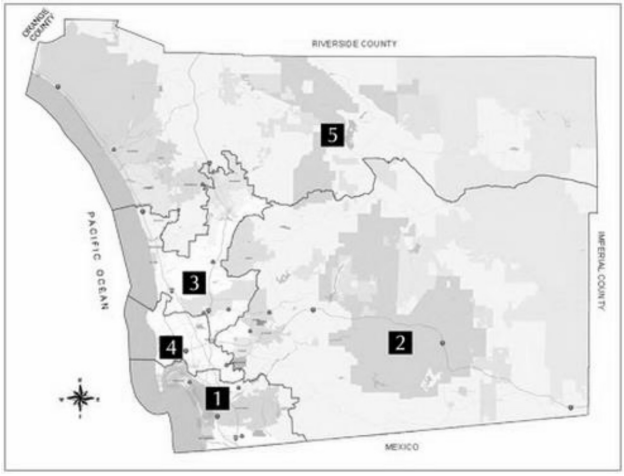

Figure 3. Map of the County of San Diego showing Five Political Divisions. Source: http://www.sdcounty.ca.gov/general/bos.html

Environmental Resources Management (ERM), a third-party verifier approved by TCR, to verify the CoSD 2010 GHG inventory. CoSD also solicited the help of the California Center for Sustainable Energy (CCSE) to identify and quantify emissions from the CoSD fleet sector.

The process of creating this large governmental GHG emissions report is discussed in the narrative below, which contains two main sections: **Methodology** including but not limited to descriptions of the processes that are reported, data collection, and calculations of emissions; and t**hird-party verification** which discusses the activities and problems encountered during this process.

METHODOLOGY

Reporting Process

TCR requires participants to report emissions in the form of six of the main sources of GHG, which are:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)

- Perfluorocarbons (PFCs)
- Sulfur Hexa-Fluoride (SF_6).

To create a common denominator, these GHGs are normalized by converting each substance to CO_2 "equivalent" (CO_2e) using the 100-year global warming potential (GWP) factor of each substance. The GWP factor is a multiplier that scales each GHG relative to CO_2, as defined by "the ratio of the heat-trapping ability of each GHG relative to that of carbon dioxide." [7] For example, a molecule of CO_2 is equal to 1 CO_2e; a molecule of CH4 is equal to 21 CO_2e; a molecule of SF_6 is equal to 23,900 CO_2e.

Additionally, there are three different types of categories (known as scopes) of emission sources that identify the level of control over emissions that an organization can exert. CRIS identifies these as follows:

- Scope 1 includes direct emissions from sources owned by an organization (vehicle or heating/cooling plant) or anything that a facility emits directly.
- Scope 2 includes indirect emissions from purchased electricity.
- Scope 3 includes other indirect emissions from the production of purchased materials or outsourced activities, such as contractor owned equipment or employee travel using vehicles not owned by the organization.

Scopes 1 and 2 are required to be reported while Scope 3 is an optional category in which the user can opt for whether or not to report it. The CoSD has not reported for Scope 3, which can be difficult to quantify.

Aside from the requirements for the TCR, the CoSD GHG report is divided into sectors which were determined from the CAP. These sectors are as follows:

- Airport Facilities
- Building and Facilities
- Energy Embedded in Water
- Fleet
- Landfills/Solid Waste Facilities

- Public Lighting
- Government Generated Solid-Waste (optional)
- Wastewater Facilities

For the sake of brevity, CoSD selected to report the largest emission sites individually and combine the rest of the sites as one facility. This is because CRIS provides the option to report each facility individually where a single facility represents a large portion of total emissions. For example, in the building sector, there are 51 facilities reported, which include the top 50 electricity consuming sites reported individually and 1 report which contains data from the remaining sites. These top 50 electricity consuming sites represent about 80-90% of the total electricity consumption of the CoSD. This strategy enables savings in time and human resources. Additionally, since the purpose of this GHG report is to keep track of the progress of the CoSD in reducing its footprint, the greatest energy reduction will be gained from projects that retrofit the largest energy-use sites, while retrofits at the lower 10-20% of energy-use sites will achieve minimal fluctuations in overall emissions.

Data Collection

CoSD staff collected raw data by downloading from electronic sources, gathering field data directly from some facilities, and requesting data from individual departments that collect their own data. Issues arise during execution of each of these methods, including human error, inaccuracy, and lack of available data. The problems with collecting raw data as well as solutions are discussed specifically for each sector.

AIRPORT FACILITIES are those operated and maintained by the County of San Diego. Emissions from energy sources are produced by airport functions, airport buildings, and use of treated/imported water. Electricity is considered as scope 2 for purchased electricity while natural gas is considered as scope 1 for stationary combustion (both of which are required to be reported). The data for these two emissions sources are the utility bills for each facility reported into CRIS. The CoSD uses a software called Utility Manager Pro which allows certain utility companies (such as SDG&E) to electronically upload the bills onto a centralized location. A centralized location refers to a single place where a person can go to retrieve information such as a common server on the computer. With this software, data collection is as simple as clicking a

few buttons to download the energy consumption.

Other information required may not be as easily obtained, such as the concentration of Btus per therm of natural gas which varies at locations around the county. The addresses of each site must be recorded and mapped to a "Thermal Zone" classified by SDG&E. Each thermal zone has a different "Btu/scf" stating that each zone has different energy content per volume of the gas, as illustrated in Figure 4. This information is generally needed to report for the airport facilities.

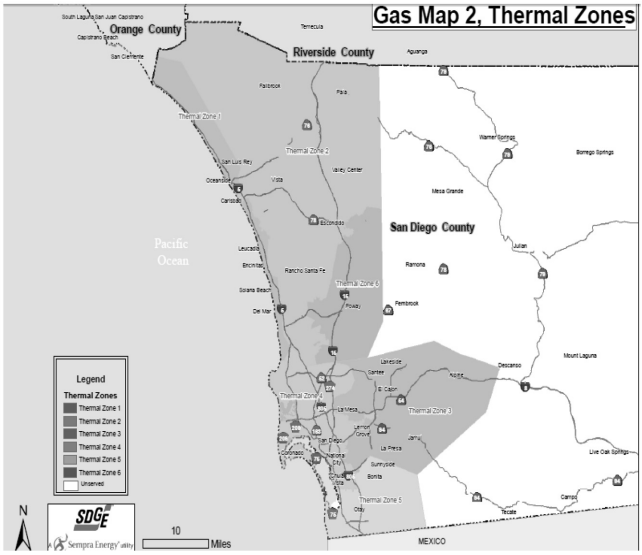

Figure 4. Partial Map of San Diego County Showing Thermal Zones. Source: SDG&E

BUILDINGS and FACILITIES sector includes the same emission sources as the airport sector. However, there are additional sources of emissions from fugitive refrigerants used by chillers and fuel from emergency generators. Furthermore, building facilities at the county may be partially leased or jointly owned (with the state) which leads to partial reporting of sources for these sites.

Refrigerants (fugitive) are classified as scope 1. Data collection for these requires staff time for field work because there is currently no centralized location for these data. The only centralized data that existed were the spreadsheets of descriptions/location of each chiller which

span across the 4,500 square-miles of the CoSD. The protocol for recording fugitive refrigerants is pen and paper in a log book at each site. The data are gathered individually for a total reporting of these emissions. Data needed to quantify refrigerants are the amount stored, purchased, returned, taken-out of equipment, and added to equipment which leads to a mass-balance approach discussed in the calculation section.

Emergency generators are classified as scope 1 for stationary combustion. There are different generators that can use different fuel types. Many different departments can take care of these generators which include portable generators that are not made known to all departments. This adds to further difficulties when obtaining the raw data collection. In general, the run-time, size, and type of generator need to be collected to calculate these stationary combustion emissions.

Land tenure is the description of the degree of ownership and control over county occupied facilities. Certain buildings or airports can be leased from a third party. This means that these sites (or parts of them) can be excluded from the GHG emissions report if the CoSD has no operational control over them. Data for these are centralized in a data base inventory and listed as either owned, leased, third-party, state owned, or district owned. Additionally, the size (gross square feet) of the site is gathered.

ENERGY EMBEDDED IN WATER has the same source emissions as airport facilities, and data are centralized in the Utility Manager Pro software. Examples of such sites are pump stations where the electricity bill is used to find their energy consumption, hence their greenhouse gas emission.

FLEET source of emissions is the mobile combustion of the vehicles reported as scope 1. Data are centralized on software known as M5. The raw data can include the number of miles traveled per vehicle, type/fuel efficiency of vehicle, and amount of fuel used by the vehicle.

LANDFILLS are those operated and maintained by CoSD and currently inactive. The sources of emissions from them are either fugitive and caused by out-gassing of buried organic material, or flared which are captured and burned off gasses. Both of these categories are considered scope 1 for fugitive and stationary biomass combustion. The data collected were the amount of gas flared per year, the efficiency of flaring

of the gases, and the frequency of ignitions for the pilot light at each site. These data are already recorded electronically by CoSD for other purposes.

PUBLIC LIGHTINGS are streetlights whose electricity use is tracked with Utility Manager Pro software. There are lighting electricity data that are not tracked by this software. Collecting these data requires communication with the owning departments.

WASTEWATER treatment facilities emit GHG from the water treatment process (scope 1 for process). The data collected for this calculation are obtained from a centralized location and show the population served at each facility.

Overall, the raw data collection process is more efficient if there is a centralized location to obtain the data. Emissions such as fuel from emergency generators and refrigerants from chillers are currently not centralized, and the current process is laborious. This process could be made more efficient by creating an electronic logging process in addition to keeping hard copies of the usage. Currently, CoSD is transitioning to using Microsoft Share Point as a centralized electronic location for this data collection until other proficient and allowable programs can be adopted.

Calculation of Emissions

The sources of emissions that need calculations are the following: purchased electricity, stationary combustion, stationary biomass combustion, mobile combustion, fugitive emission, and process emission. For facilities owned by CoSD, the method for gathering data is simply extracting data from Utility Manager Pro. However, for those facilities that are not directly owned (under different land tenure), a more complex calculation method was required as discussed later on. Additionally, stationary combustion includes both the natural gas emissions and the fossil fuel emissions. Fugitive includes both the refrigerants and the landfill gas. Process emissions include both the pilot light and wastewater treatment. In general, the raw data collected were used to calculate the GHG measurements which are converted to CO_2 equivalents. Much of this calculation deals with using emission factors provided by TCR, which are updated annually. [8] The LGOP requires that the reporting of

each source must use the emission factors closest to the year for which the report is registering (i.e., 2012 data must use 2012 emission factors unless they are not available, and therefore, the 2011 or 2013 emission factors must be used). [9]

PURCHASED ELECTRICITY data are collected in units of kilowatt-hours. Because electricity is generated by differing mixtures of fossil fuel types and renewable sources, the GHG factor per kWh will vary with locality. By specifying in CRIS the eGRID of the electricity purchased (i.e., WECC California), the correct emission factors in units of GHG/energy (i.e., CO_2/MWh) can be calculated. Energy data in kilowatt-hour are then converted to CO_2, CH_4, and N_2O emissions.

STATIONARY COMBUSTION emissions data, are in units of therms for natural gas and gallons for fossil fuel. By specifying the thermal zone for natural gas and type of fuel for fossil fuel, the correct emission factors are used to convert the data into GHG emissions. If the data for the fossil fuel is in hours of runtime and type of emergency generators, then there are universal factors (such as generator fuel consumption per time) that need to be entered to convert this into gallons of fuel used and then into the GHG emissions.

STATIONARY BIOMASS COMBUSTION data are provided in square-cubic-feet, SCF, of flared landfill gas. With conversion and emission factors, the CO_2, CH_4, and N_2O emissions are calculated and entered into CRIS.

MOBILE COMBUSTION data are entered into CRIS in miles or gallons. Again, the emission factors are used to calculate its CO_2, CH_4, and N_2O emissions.

FUGITIVE emissions include the refrigerants and landfill gas. Refrigerants raw data are in units of kilograms which are converted to metric tons. Prior calculation is needed with the mass balance approach to calculate the exact fugitive emissions of refrigerants (i.e. leaked HFCs). Simply, the mass balance approach, following equation 6.29 in LGOP, is just the amount of additional refrigerants needed to replace the leaked refrigerants. Technically, these refrigerants are already reported as GHG emissions or HFCs so emission factors are not needed. However, GWP

are used to convert the HFCs to CO_2e. For fugitive landfill gas, the data are in units of SCF of flared gas. Following the LGOP, equation 9.1 is followed to convert these data into the amount of fugitive methane gas. [6] This equation includes default values of concentration of methane, destruction efficiency, collection efficiency, oxidation factor, and unit conversion. Both calculated values for fugitive emissions are input into CRIS.

PROCESS emissions are calculated from the pilot light data from landfills and quantity of population served for wastewater treatment facilities. Pilot light emissions are very low and therefore fall into the LGOP *de minimis* category in which an alternative method of reporting the source is allowed if the sum of the sources "equals less than 5% of an organization's total emissions." [9] Since pilot lighting was not an option in CRIS or LGOP, an alternative method was used to calculate emissions of GHG from pilot lighting. Ignition frequency data were used to convert into emissions of CO_2. These conversion factors include gallons of propane per ignition, propane combustion ratios, molar masses, etc. The end product is metric tons of CO_2e. As for population served, equation 10.7 and 10.8 in the LGOP were used to convert the population served value into metric tons of N_2O emissions. These conversion factors were an "emission factor for a WWTP [waste water treatment plant] with [or without] nitrification/denitrification" and metric ton to gram conversion. [9] The final value of N_2O is entered into CRIS and converted to CO_2e.

FACILITIES OWNED BY COSD are organized through the operational control approach where the CoSD accounted for facilities over which it has operational control. These include wholly owned facilities where the county has full authority to introduce and implement operational policies (refer to Table 3.1 of CRIS protocol). CoSD has seven types of facilities, as shown in Figure 5. Following the general protocol, all facilities in the county were categorized by the types in Figure 5 and by availability of data.

For the sites with no data availability, the CRIS protocol suggested two methods to estimate the energy usage. The first method uses the energy rate or energy per area from either the California Commercial End-Use Survey (CEUS) or Commercial Building Energy Consumption Survey (CBECS) to obtain the approximate energy usage per site with

Tenure	Control Over Utility	Control over Equipment Maintenance	Method	Include in Inventory
Owned – Wholly owned	Yes	Yes	Use utility consumption without modification	Yes
Owned – Partial Occupancy	Yes	Yes	Use utility consumption with proportional leased or district SF subtracted	Yes
Leased – With O&M Responsibility	Yes	Yes	Use utility consumption without modification	Yes
Leased – no O&M Responsibility	Yes	No	Use benchmark emissions per SF	Yes
District	No	Yes	Remove utilities proportionately from site	No
District	Yes	Yes	Use utility consumption without modification	No
Third Party	No	No	Exclude from Inventory	No

Figure 5. Land Tenure Chart

a given square footage. The CEUS or the CBECS are comprehensive studies of commercial sector energy usage, designed to support energy demand forecasting and approximation activities. CBECS survey covers a national sample while the CEUS involves samples only in California, which may be more relevant or comparable to COSD facilities.

The second method requires that all the available data for COSD facilities are to be categorized into and surveyed by specific classes. Afterwards, a rate of energy/area can be computed per class of building. Then, the rate can be applied to the building to find the approximate energy usage. Since COSD facilities are employed in the survey, it is more likely that the rates found will be better compared than the rates found from CEUS or CBECS. In addition, since COSD operates a wide variety of buildings, some with multiple functions, it makes more sense to survey COSD sites.

To justify method 2, an experiment of two different methods was carried out for the 2010 and 2011 leased sites with no data. The results are listed in Figure 6. The CEUS results showed a higher estimation of the electricity usage while the COSD surveyed site method revealed a higher estimation for natural gas usage. Since some of the COSD buildings are also powered by central plants, it is probable that the estimation from the COSD surveyed site method would produce more accurate results because the method used was based on CoSD usage behavior.

The calculation process follows the LGOP strictly and has room for error if the data collection process was incorrect. By incorrectly specify-

Method	Year	Electricity (kWh)	Natural Gas (therms)
COSD Comparable Site Method	2010	14,755,486	278,367
	2011	13,594,838	267,613
Using CEUS Method	2010	15,709,177	165,085
	2011	14,263,879	135,102

Figure 6. COSD Survey Method Compared to CEUS Method for Electricity and Natural Gas

ing a source (i.e., wrong fuel type for fossil fuel), a different value of emissions would be reported. Over-reporting of the GHG emissions can cross the line between correctly projecting emissions and ineffective emissions reduction efforts. Under-reporting can lead to a small marginal difference in GHG reduction in the following year. In general, much attention needs to be paid to the details of each source emission (i.e., fuel type, location of emission, units, etc.). Third-party verification helps to create an accurate and an assured GHG report.

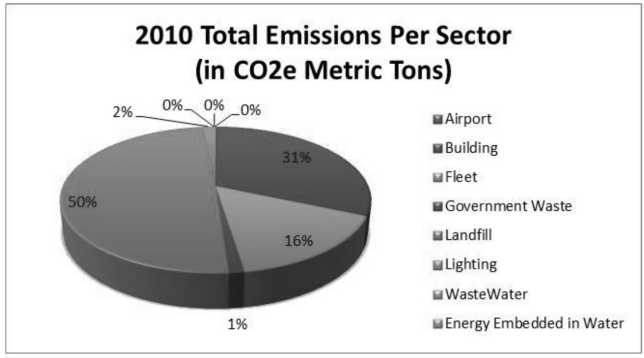

Figure 7. Distribution of Emissions by Sector, as of August 5th, 2013

THIRD-PARTY VERIFICATION

Choosing the Third-party Verifier

The purpose of the verification process is to ensure a faithful, thorough, and independent assessment of the CoSD's GHG emissions. The verification body is required by the TCR to be composed of a team with

four types of technical experts who, upon completion of the verification, will provide a verification report and a verification statement. TCR will then review the reporter's verification and release the successfully verified data to the public, accessible online via CRIS.
TCR lists several criteria by which a third-party verifier or a verification body is to be selected, as referred by the General Verification Protocol (GVP). First and most importantly, the verification body must be approved by the TCR by becoming accredited for registry participation.

From the pool of accredited verifiers, the reporting organization should select the verification body that has prior experience with other reporters of similar sized GHG inventory, where verifiers would have a better assessment of risk management and a better estimate of the scope of work. Another criterion in selecting a verifier concerns the Conflict of Interest (COI) assessment conducted by the verification body where TCR will review and approve the COI assessment prior to finalization of contract between the verifier and the reporter. Through the COI assessment, the verification body reveals their relationship with prior or current reporter(s) and whether a conflict of interest occurred in the past. Moreover, the verification body shall describe the financial magnitude of the service agreement with the reporter and other information such as ability to have additional subcontractors beyond the required technical experts.

Once the reporter chooses a verification body, the verification body should provide the terms of contracts and scope of work that can be subjective to negotiation and that is to be finalized. Once the verification contract is finalized, the verification body is to develop a verification plan and proceed with the verification process.

In the case of CoSD, the Environmental Resource Management (ERM) firm provided the verification of the 2010 CoSD GHG report. The process started in 2012 during which the contractors were chosen, consultants were assigned, and visits were scheduled. In late 2012, the site visits occurred in which a few sectors were chosen to be verified. The facilities visited included several landfill gas sites and significant building sites. During staff interviews, questions were asked about the raw data collection as well as some of the calculation methodologies. In general, if the verifier believes that the raw data collection process was valid, then the data used by CoSD for the GHG report could also be used by the verifier for a comparison report. This report was conducted based on the LGOP and is then used to compare with the CoSD report to within an accuracy of 5% based on the *de minimis* category.

Level of Assurance

The level of assurance indicates the relative degree of confidence in the accuracy in the reported data by the third-party verifiers. By extension, the level of assurance also dictates the level of confidence that the Registry or other users can place in the reported information. There are two levels of assurance, reasonable and limited. Reasonable assurance represents the highest level of confidence where the third-party verifier declares that the reported data are correct, while limited assurance from a third-party verification indicates that there is insufficient evidence to determine that the reported data are incorrect. [10] In other words, the standard of verification for each assurance level differs in terms of accuracy (how accurate the county is in reporting all the emissions versus how accurate the county is in calculating the already reported emissions), resulting in different levels of confidence.

The third-party verifier's scope of work for full verification was initially intended to result in reasonable assurance. However, after the verification process was completed, the verifier found that a more in-depth investigation of the GHG report would be needed to grant a reasonable assurance. The cost of a more in-depth investigation exceeded available funding, and therefore the verification result of the 2010 emissions report remains at a proposed level of limited assurance. As of July 24, 2013, the third-party verifiers were in consultation with TCR to determine if a limited assurance could be granted to the CoSD. This would automatically be approved as part of a batch verification, which includes reports characterized by "small office-based organizations" with "1000 metric tons total CO_2e emissions, with no significant process/fugitive emissions" [10]. CoSD is outside these parameters. Therefore, the TCR policies will be affected if this is the route that is taken.

Benefits of Third-party Verifications

During the verifiers' site visits, several additional sources of emissions were revealed that the original 2010 GHG report had not included. Several errors in the data reporting were also brought to light. Examples of additional sources are fugitive chiller refrigerants, landfill gas pilot lighting, and the land tenure estimating process. After the site visit in early 2013, a corrective issues log was presented to the county in which the issues in the GHG report were addressed along with the solution to the problems found. The CoSD proceeded to address these issues and found that several could not be resolved due to the large amount of

human resources needed for data collection, mostly involving the collection of fuel consumption from each emergency generator and leaked refrigerants from each chiller. Although this information was not collected in 2010, making reasonable assurance unlikely for that reporting year, a protocol is being implemented for employees to record data in a centralized location by 2014.

As expected, the result of third-party verification assured the accuracy of the calculated emissions. Additionally, the verification process provided guidance in establishing a correct framework for future reporting periods. Unexpectedly, the issues uncovered by the third-party verification process revealed the flaws in maintaining accessible documentation in a centralized location, particularly given that many assets are managed by different, uncoordinated groups.

CONCLUSION

This large government body GHG report is highly complicated. The many sectors, along with the many source emissions per sector, created complications during the raw data collection in determining source emissions. We hope the description of the creation and third-party verification process provided here will help guide other large entities to create their own GHG report.

The CoSD's plan is to rectify the issues that exist in the current GHG reports, to assure higher confidence for future reports. To rectify current issues, new protocols will be implemented, so that responsible employees can document their work in a centralized location (i.e. after refueling a generator, record the fuel consumption electronically), saving time and ensuring quality assurance. With these issues fixed, the GHG report can finally be used to track the county's progress in reducing its GHG emissions.

Suggestions from the Authors

To summarize the suggestions from the authors, below is list of recommendations:

- START THE INVENTORY EARLY. The 2010 greenhouse gas emission was started in 2011, the verification did not come back until the end of 2013, and two additional inventories had already been created prior to solving the issues with the 2010 inventory.

- CENTRALIZE ALL REQUIRED DATA. It can take a whole year to gather data, unless rules have been set to record the data in a centralized location. This suggestion applies to both large and smaller governmental bodies and the private sector.
- THINK GREEN. By using non-GHG emitting ways of operating your facilities, you will not need to report any GHG emissions.

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