

King County Housing Authority Greenhouse Gas Inventory Report – 2018 Update

February, 2020

I. Introduction

In 2018, the Resource Conservation department of King County Housing Authority (KCHA) completed its first comprehensive greenhouse gas (GHG) inventory assessment for the previous year. The project, consisting of a study and a report, addressed GHG emissions generated in the year 2017, and examined Scope 1, 2, and 3 emissions of KCHA's operations. Prior to the assessment, KCHA reported on annual GHG emissions for its building energy consumption only, and did not examine GHG emissions associated with transportation, materials, and waste disposal. The purpose of the first assessment was to better understand the ways in which KCHA plays a role in GHG emissions, and also set baselines to measure against for future assessments.

In this assessment, we update emissions for 2018 and compare against the 2017 baseline year. Through this process, we better understand GHG trends, and make recommendations on how to cut emissions. The results of this report will be used to develop emissions reduction targets for future years, as well as strategies to meet the targets. This report aims to achieve the following objectives:

- a. Quantify KCHA's GHG emissions for 2018
- b. Compare emissions to the baseline year (2017)
- c. Make recommendations to reduce GHG footprint

II. Basics of GHG Inventory

Climate change is widely regarded as one of the most pressing global issues of our time, and often called an existential crisis. The United Nations International Panel on Climate Change (IPCC) reports that climate change is having, and will continue to have profound adverse effects on the health of the world's oceans, fresh water quality, forests, food sources, and built environments. Therefore, it is imperative that KCHA plays its part in reducing GHG emissions. In doing so, KCHA leads the way for other public housing authorities to combat climate change.

Quantifying Emissions

It is important to use the same methodology when calculating GHG emissions for different years, in order to ensure that the resulting metrics are comparable. The same operational boundaries defined in the original report were used. However, we occasionally do find improvements to calculations. For example, utility fuel mix disclosures were updated after the publication of the 2017 report, so we updated our calculations accordingly, and rereleased the report with the improved data. A detailed methodology for quantifying each GHG emissions metric can be found in the report for the 2017 calendar year, but to summarize, emissions sources are categorized into three groups, or "scopes", depending on their degree of control KCHA has in its generation.

- Scope 1: Direct emissions owned or controlled sources. For example, emissions from company vehicles.
- Scope 2: Indirect emissions from generation of purchased energy. For example, emissions from purchased electricity.
- Scope 3: Upstream and downstream emission activities. Emissions associated before and after the creation of a product, such as transportation or capital goods.



Figure 1 - Diagram of Scope 1, 2, and 3 of GHG Emissions

Greenhouse Gases (GHGs) and Global Warming Potential (GWP)

GHGs trap heat in the atmosphere differently, depending on the radiative properties and lifespan of the gas. Some gases may absorb and reemit large amounts of energy but only last a short while in the atmosphere, while others may have little radiative properties but may do so for many years. These characteristics make comparing impacts of GHG somewhat difficult, so the concept of global warming potential (GWP) was developed to allow for comparisons and to help standardize impacts of these different gases. The GWP of a GHG is the measurement of how much energy one ton of that gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide¹ (CO₂). The standard duration used with GWP is 100 years.

- Carbon dioxide (CO₂): Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement).
- Methane (CH₄): Methane emissions result from fossil fuel extraction and transportation, livestock byproduct and other agricultural practices, and by the decay of organic waste in municipal solid waste landfills.
- Nitrous oxide (N₂O): Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- Fluorinated gases are synthetic, powerful GHGs emitted from different industrial processes. They are used inside products like refrigerators, air-conditioners, foams, and aerosol cans. These are typically emitted in smaller quantities but are very potent atmospheric gases. Their measurement needs greater scientific attention and precision before reliable emission factors can be developed for wider use by organizations for updating their GHG inventory.

The U.S. Environmental Protection Agency (EPA) considers GWP estimates presented in the most recent IPCC scientific assessment to be true. The GWP assumptions (listed in Table 1 - Common GHGs and their global warming potential (GWP), below) this piece of work utilizes are from the IPCC's Fifth Assessment Report, published in 2014.

| Greenhouse gas | Global warming potential (GWP) | Normalized equivalence |
|--------------------------------------|-----------------------------------|--|
| Carbon dioxide (CO ₂) | 1 | 1 metric ton (MT) of $CO_2 = 1$ MT of CO_2e |
| Methane (CH ₄) | 28 | 1 MT of $CH_4 =$ 28 MT of CO_2e |
| Nitrous oxide (N ₂ O) | 265 | 1 MT of N ₂ O = 265 MT of CO ₂ e |

Table 1 - Common GHGs and their global warming potential (GWP)

¹ United States Environmental Protection Agency (EPA)

III. Boundaries of KCHA inventory

Defining the boundaries of a GHG inventory study is the most critical and tricky task. Every object we use in our daily lives, directly or indirectly, has a greenhouse gas footprint. Every object is made using energy (created using a fuel) or is made up components which utilized energy in their own manufacturing processes or objects release GHGs when they decompose. For a housing authority, release of GHGs is associated with resident properties, corporate offices, employees and all supporting activities to provide affordable housing for low income communities. More specifically, this includes electricity and gas consumption at KCHA properties and central offices, consumption of fuel during employee commutes, disposal of residents and employees' solid waste at the Cedar Hills landfill, consumption of various construction materials, among others. Figure 3 below offers specifics of what is included in the 2017 analysis and what is not included.



Figure 2 - Sources of GHG Emissions at KCHA

Based on internal KCHA interviews in the first two weeks of the baseline study, the boundaries for this project were decided after consulting department heads and getting a sense of what information is available, what can be collated in a few weeks and what cannot be measured at all or without a certain degree of confidence given the prevailing data management mechanisms. 2017 was chosen as the baseline year as it's the most recent year for which KCHA has reliable information about its energy use among other categories. We engaged with Seattle Housing Authority (SHA) to understand the boundary of their GHG inventory study. King County's Senior Climate Change Specialist Matt Kuharic was consulted for finalizing our scope of work².

² KCHA 2017 GHG inventory excludes water and waste water related emissions as Matt Kuharic suggested that these emissions are almost insignificant

IV. Results

Quantifying emissions from each GHG source was done using methodologies specific to each category of emissions and is disclosed below. For conceptual clarity and assumptions (where KCHA specific data wasn't available), KCHA relied on the International Council for Local Environmental Initiatives (ICLEI) Community Protocol for Accounting and Reporting of GHGs.

KCHA's 2018 total GHG emissions are measured to be 35,842 metric tons of carbon dioxide equivalent (MT CO₂e). This accounts for a reduction of more than 2,400 metric tons compared to 2017 levels.



Figure 3 - 2017 and 2018 GHG inventory comparison (MT CO₂e)

While the GHG analyses for these individual sources of emission are explained later in this section, it is important to consider these emissions from an operational boundary perspective so as to disaggregate these emissions into scope 1, 2, and 3 which then allows an organization to get a more wholesome sense of their emissions and how much control do they have over the various sources of emissions.

| Sector | Scope 1 | | Scope 2 | | Scope 3 | |
|-----------------------|---------|-------|---------|--------|---------|-------|
| YEAR | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| Electricity | | | 28,582 | 26,126 | | |
| Natural gas | 1,955 | 1,946 | | | | |
| Employee commute | | | | | 5,807 | 5,807 |
| Solid waste | | | | | 835 | 838 |
| Fleet | 447 | 421 | | | | |
| Construction material | | | | | 324 | 608 |
| Air travel | | | | | 117 | 96 |
| Total | 2,402 | 2,367 | 28,582 | 26,126 | 7,082 | 7,346 |

Table 2 - KCHA 2017 GHG Emissions, by Scope (MT CO₂e)

It's important to note that Scope 2 emissions are the largest for KCHA since electricity consumption is the biggest source of GHG emissions. While KCHA residents and employees do have some control over consumption, they do not control what fuel mix the concerned utilities use to produce that electricity which governs emissions associated with electricity. This is covered in detail in the buildings' energy section below.

A. Buildings' energy

Methodology

The GHG emissions associated with electric power and gas heating were calculated using KCHA property energy consumption data and carbon contents from utility fuel mix disclosure reports. Energy usage data was shared by the utilities with Energy Star Portfolio Manager, which collects energy consumption data on a whole building level.

Results

Emissions associated with KCHA building energy consumption in 2018 dropped by 2,465 MT CO₂e. The reduction is driven by two changes to building energy consumption. 2018 saw an overall decrease in energy consumed—particularly from properties that have Puget Sound Energy (PSE) as their electricity or gas utility. This is important because a significant amount PSE electricity's fuel mix is from fossil fuel energy sources, whereas Seattle City Light (SCL) receives nearly all of its electricity from hydropower. Additionally, both PSE and SCL purchased a greater share of renewable energy as part of their electricity portfolio, which reduced its carbon intensity (the amount of carbon emitted per kBtu of energy produced) by nearly 7 percent.



Figure 4 - GHG intensity of energy produced in 2017 and 2018

Both residential and commercial buildings achieved modest reductions electricity and gas consumption per square foot, compared to the previous year. Savings range between 5% and 13%, with no change to community building electricity consumption, and a 6% increase in electricity consumption at semi-detached buildings. When examining emissions per resident, nearly all properties achieved reductions, with semi-detached properties recording an increase in energy consumption per person. Appropriately, semi-detached homes also are responsible for the greatest proportion of natural gas in their energy consumption mix.



Figure 5 – 2018 Energy related GHG emissions per sq. ft. by building type



Figure 6 – 2017and 2018 GHG emissions per resident, by building type

B. Employee Commuting

Methodology

In 2018, employees were asked to complete an online survey to disclose their commuting habits. The survey results revealed how far employees typically commute, and what modes of transportation they use. While the survey was conducted again in 2019, the data reflects 2019 habits; the original data was reused in this report, hence why there is no change to commuting habits and their associated emissions.

Results

Employees overwhelmingly use their personal vehicles as their primary mode of commuting—likely due to KCHA office locations and ample parking provided at properties. However several use a combination of public transit services including buses, Link light rail, Sounder train, and Washington State Ferries. Additionally, some employees use carbon neutral options like cycling, walking, and telecommuting.



Figure 7 – KCHA employee trips per week by transportation mode, 2018

Over 5,800 MT of CO₂e annually is produced by KCHA employee commutes. Due to the low emissions fuel and energy efficiency of alternative transit options, the vast majority of those GHG emissions are from personal vehicle travel. Telecommuting, while rarely utilized by KCHA employees, prevents nearly 192 additional MT of CO₂e due replacing personal vehicle commutes.



Figure 8 - Weekly GHG emissions from KCHA employee trips by transportation mode, 2018

C. Solid Waste

Methodology

The Resource Conservation team maintains records for collection of solid waste from properties and central offices. Ideally, we would collect receipts of actual tonnages of KCHA related waste from the

various haulers who work with KCHA. While tonnage data can be collected for compactors, which several properties have, the vast majority of waste is collected in dumpsters for which we are charged by volume—not tonnage. This effort leveraged the compactor tonnage and dumpster volume and frequency of pick up to estimate the amount of solid waste collected, transported and processed to generate electricity at the Cedar Hills facility. Emissions associated with solid waste are largely due to the decomposition of solid waste that take place at the landfill. In addition to some carbon dioxide, methane is a major GHG released when this solid waste decomposes (much of it can be captured for further electricity generation). Emission factor assumptions from International Council for Local Environmental Initiatives (ICLEI) were used.

Results

Solid waste GHG emissions from resident and employee activities in 2018 rose from 835 MT CO₂e to 838 MT CO₂e. The proportions of emissions remains similar to the previous year, while the overall increase can be attributed to an increase in resident occupancy at KCHA properties. The collection and transportation of the waste is relatively small (104 and 10 MT CO₂e, respectively), compared to emissions from landfill. Recall that methane is 28 times more potent than carbon dioxide for global warming, which is why even with 92% gas capture efficiency³ at the Cedar Hills facility, 724 MT CO₂e emissions still escape into the atmosphere.

Per calculations from Resource Conservation's solid waste analysis, a total of 5,013 metric tons of garbage was estimated from KCHA properties and Central Offices. The garbage tonnage amount, listed above, excludes the recyclable and yard waste that is diverted away from going to landfills. In fact, current diversion rate of ~45% is keeping at bay ~674 MT CO₂e of emissions.

³ ICLEI recommends using 75% as the gas collection efficiency in the absence of data from the requisite facility.



Figure 9 - Solid waste related GHG emissions, 2018 (MT CO₂e)

D. Fleet

Methodology

For calculating emissions associated with the KCHA fleet, vehicle usage information was obtained from ARI Fleet Manager. This portal, which KCHA subscribes to, successfully captures fuel consumption for all the different vehicles within KCHA's fleet. Suitable emission factors were used for different car segments and methane and nitrous oxide emissions were estimated using EDF-NAFA⁴ Fleet GHG Emissions Calculator.

Results

The KCHA fleet, comprising of light duty trucks, vans, SUVs, passenger cars and non-road vehicles like lawn mowers, etc. accounts for ~421 MT CO_2e in 2018. Through ongoing efforts to transition the fleet off of conventional fossil fuels, like gasoline and diesel, KCHA achieved a 6% reduction from the 2017 baseline year. The major sources of reduction were with non-passenger vehicles. Even though passenger vehicle use was up by 12% in 2018, emission reduction with light duty vehicles, and non-road vehicles drove down overall emissions by 26 MT CO_2e .

⁴ NAFA Fleet Management Association



Figure 10 - Fleet related GHG emissions, 2017 and 2018 (MT CO₂e)

E. Construction material

Methodology

Construction material remains a challenging category to account for emissions, given the way material is procured and the range of materials being used. The Capital Construction and Asset Management teams compiled information from some of their larger projects in 2018 and estimate quantities used by contractors.

Results

Construction materials is the sector that increased emissions the most. In 2018, construction materials accounted for 608 MT CO₂e emissions—or nearly 190% of 2017 emissions of 324 MT CO₂e. While this data is based on assumptions about construction materials used, and the emissions associated with construction materials in general is likely to be a much bigger emissions category, it does show that construction and maintenance activities in 2018 were substantial. Year-over-year increases were observed across almost every material measured, with the largest increase attributed to concrete.



Figure 11 - Construction material related GHG emissions, 2017 and 2018 (MT CO₂e)

F. Air Travel

Methodology

Emissions from flight travel were calculated using the Myclimate Flight Emission Calculator, available online for free. The website calculates GHG emissions on a per person basis using airport coordinates, distance traveled, fuel consumed and typical plane size. Full details behind Myclimate's methodology are available online.⁵

Results

Air travel in 2018 made up 96.05 MT CO_2e of KCHA's GHG emissions. This is a reduction of 12 MT CO_2e , or 11% compared to 2017. Air travel GHG emissions were assessed on a per seat-mile basis using an air travel GHG calculator, available online. 200 flights were taken by employees (eight fewer than in 2017).

⁵ https://www.myclimate.org/fileadmin/myc/files_myc_perf/12_flight_calculator_documentation_EN.pdf



Figure 12 - Flight routes of KCHA air travel, 2018

| Destination | # of Flights | Round-trip Miles Traveled | MT CO ₂ e | MT CO₂e per Seat Mile |
|----------------|--------------|------------------------------|----------------------|--------------------------|
| Washington, DC | 17 | 79,598 | 22.2 | 0.00028 |
| Atlanta, GA | 11 | 47,846 | 13.2 | 0.00028 |
| Las Vegas, NV | 6 | 10,439 | 3.19 | 0.00031 |
| Nashville, TN | 6 | 23,861 | 6.6 | 0.00028 |
| Austin, TX | 6 | 21,251 | 5.98 | 0.00028 |

 Table 3 - Most frequent flight routes of KCHA air travel, 2017

V. Recommendations

2017 GHG inventory study set the baseline for methodology and results. The 2018 study solidifies the results from the 2017 study and provides us with a roadmap forward to reducing GHG emissions.

Next steps for GHG inventory development

- *Energy Consumption* KCHA's longstanding commitment to improving energy efficiency of its building stock is a major reason why GHG emissions are not significantly higher. Reducing energy consumption in buildings not only remains the most cost-effective GHG reduction strategy but also directly addresses the largest sector in KCHA's GHG portfolio. It is strongly recommended to double down on energy efficiency as a major area of focus by expanding energy efficiency strategies beyond weatherization and into equipment commissioning. Furthermore, it is recommended to continue pursuit of renewable energy sources—both on-site solar and purchased power from a utility—and curb off of natural gas usage.
- *Employee Commute* cutting emissions associated with commuting remains challenging. Given that KCHA employees commute to work using a wide variety of transportation options, and that place of work can span the county, it is difficult to come up with a program to affordably encourage alternative transportation options with employees. However, one of the most cost-effective and simple ways to reduce GHG emissions from commuting is to increase the number of telecommuters per week. While telecommuting is not a realistic option for everyone at all times, it can substantially reduce number of single occupancy vehicle trips to/from the office, and save employees money. The environmental benefits of telecommuting are more pronounced when considering that traffic volume trends are rising, regionally. It is recommended to promote and expand on KCHA's telecommuting policy in effort to increase usage.
- *Solid Waste* continue to engage with residents to reduce amount of garbage sent to landfill. Increase composting and recycling at properties wherever possible.
- *Construction Material* reducing GHG emissions embedded in the materials used in construction remains a challenge. It is recommended that KCHA considers using materials that will last longer, even when more expensive in order to reduce the overall amount of materials needed to maintain a property over time. If feasible, conduct a lifecycle analysis of the material in order to better inform decision making.
- *Land Use Change* while it was not included in this study, land use change is a major driver of GHG emissions. KCHA should be cognizant of its decisions that directly and/or indirectly result in the removal of wooded areas and other (biodiverse) green spaces, as the removal of green spaces will intensify the impacts of the urban heat island effect, and decrease on-site carbon sequestration.