



# Memorandum

**To:** Carol Dollard – Colorado State University  
**From:** Terry Hatfield, Becca Stock – Brendle Group  
**Date:** October 3, 2019  
**Re:** FY18 GHG Inventory Review

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We have reviewed the FY19 GHG inventory through a two-step process. The first step was to identify any tool inputs where there was a change greater than 5% between FY18 and FY19. In each case we noted significant differences in inputs or outputs below and provided explanation where available. The second step was to review the changes in emissions from the outputs tab and ensure that in each case the change in emissions could be explained by the change in associated inputs. We have also noted any other tool concerns in the appropriate sections below. This review included the following documents:

1. GHG Calculator CJD FY19 Submission to Brendle Oct 1 2019.xlsx
2. Brendle Group Memo Sep 25 2019.docx

Additional files provided as a response to findings noted in this memo:

1. GHG Calculator CJD FY19 Submission to Brendle Oct 3 2019.xlsx
2. Scan of Notes for Brendle Group Oct 3 2019.pdf
3. Scan of Notes for Brendle Group Oct 3 2019 Page 2.pdf

## Benchmarking

1. Electricity use: 13.8 kWh/sq. ft. (+1.6% from FY18)
2. Natural gas use: 0.090 MMBtu/sq. ft. (+4.7% from FY18)
3. Transportation
  - a. 1,589 car miles/faculty member (+6% from FY18)
  - b. 151 bus miles/faculty member (-10% from FY18)
  - c. 2,130 car miles/staff member (+5% from FY18)
  - d. 167 bus miles/staff member (-20% from FY18)
  - e. 447 car miles/student (+20% from FY18)
  - f. 336 bus miles/student (-6% from FY18)

4. Electricity emissions factor: Methodology change affecting years FY18 and after, moving to a utility provider specific emissions factor multiplied by a percentage of electricity use from utility provider, as noted. Before FY18, generation mix information was used to calculate emissions factor. The FY2019 emissions factor used for City of Fort Collins (CFC) Utilities matches the one calculated from the July 2019 version of Fort Collins Utilities Energy Policy 2018 Annual Update ([https://www.fcgov.com/utilities//img/site\\_specific/uploads/energy-policy-2018-annual-update-report\\_no-petroleum.pdf](https://www.fcgov.com/utilities//img/site_specific/uploads/energy-policy-2018-annual-update-report_no-petroleum.pdf)). Overall emissions factor down from 0.6356 MT CO<sub>2</sub>e per MWh in FY18 to 0.6238 MT CO<sub>2</sub>e per MWh in FY19 (2% decrease).
5. 4.8 MT CO<sub>2</sub>e (net) per full-time student (-21% from FY18)
6. 0.0144 MT CO<sub>2</sub>e per sq. ft. (-13% from FY18)
7. Net emissions: 178,300 MT CO<sub>2</sub>e (-13% from FY18, -23% from FY10 benchmark)

## Input Notes

### INSTITUTIONAL DATA

- Since FY18, the number of full-time students increased 11% and the number of summer school students decreased -27%, respectively. Based on notes in additional documentation, this is likely due to a change in the data source from FY18 to use the official IPEDS numbers in FY19.
- In FY19 there were +9% more HDD and -11% less CDD than FY18.

### ENERGY DATA

- Natural gas use is up 5% from FY18. This may be driven by weather since HDD increased by 9% over this time. In addition, less gas was used to run the steam plant due to an increase in the gas rate that caused a shift to fuel oil. Notes provided in a memo state new construction from last year having partial year consumption data now have full year data, and are heated with natural gas-fired steam or natural gas directly
- #2 Diesel fuel increased 23% from FY18, due to fuel switching as a result of the interruptible gas rate.
- Propane increased 18% from FY18, likely also driven by weather since HDD increased by 9% over this time.
- Electricity use on campus is up by 2% from FY18. Since CDDs decreased 11% since last year and the change in square footage was flat, we might expect to see a decrease in consumption. However, based on notes provided, the new properties (about +1,000,000 square feet) that came online for a partial year in FY18 now have full year data in FY19, leading to an increase in electricity consumption.
- The amount of wood chips and wood pellets dropped to 0 in FY19. Notes provided in a memo state the biomass boiler was down for FY19, which uses wood chips for fuel. A small pellet boiler at the Colorado State Forest Service uses wood pellets.

### FLEET FUEL USE

- Diesel fleet consumption dropped -21% from FY18. Diesel fuel use varies significantly from year to year, and FY19 use is within the typical range.

### REFRIGERANTS

- R-404a is up significantly (+82%) from FY2018. Most other refrigerants are down significantly from FY2018: HFC-134a (-5%), HCFC-22 (-25%), MP39 (-67%), and R-407C (-50%). It is noted that the variation in refrigerant use year to year is because refrigerant use is tracked by purchases.

HFC-410a use remained the same from FY18, but higher than all previous years. Equipment using other refrigerants was replaced with equipment using HFC-410a in FY19, causing an increase in the refrigerant and a decrease in others.

#### AGRICULTURE

- NOTE: in general, variability in fertilizer usage and animal head counts is related to research program needs.
- The total amount of fertilizer has increased 22% from FY18, bringing the levels more in line with FY14-FY16. Nitrogen content of the fertilizer has decreased for the second year in a row, this time by 13% resulting in only a 6% increase in total nitrogen reported. This remains lower than nitrogen estimates between FY13-FY17.
- A smaller elk herd has returned in FY19 after being eliminated last year in this inventory.
- The number of swine on campus decreased by 76% from FY18, bringing the total to be more consistent with FY12-FY17 counts.
- The number of goats increased 30% from the FY18 inventory.
- The number of sheep increased by 20% from the FY18 inventory.
- The number of horses decreased by 52% from FY18 - the second year in a row of decreases after being consistent from FY14 to FY17.
- The number of buffalo increased slightly (9%) from the FY18 inventory.
- The number of camels decreased to zero. In previous years, this category has included both alpaca and camel.

#### COMMUTING EMISSIONS

All commuting data are gathered from annual self-reporting surveys conducted by Colorado State University.

##### *Student Commuting*

- The number of student trips per week is up by 10% compared to FY18, which is proportional to the increasing number of students (11%) and the decreasing number of 1-way trips per week per student (-1%).
- The percentage of students riding their bike to campus is down 7% from FY18 for the second decrease in a row.
- The percentage of trips by single occupant vehicles (SOVs) is up by 8%, which breaks a trend of decreasing mode share since FY14 and brings the overall SOV percentage of trips in line with FY17. SOV overtakes bus as the largest proportion of modes of student travel on campus.
- The portion of trips completed by bus decreased by 16% from FY18.
- The portion of trips on foot increased by 16% from FY18. The miles traveled by bus and walking are nearly equal in FY19.
- The number of miles per trip increased by 14% from FY18.
- Auto fuel economy is held constant from FY18. In 2019, the EPA estimated the national average fuel economy to be 24.7 MPG. The value used in the FY19 estimate was 22.4 MPG, which is within the expected range.
- The average carpool size increased significantly by 29% since FY18 and is the highest average since the number was first reported in FY15. The carpool mode percentage remains a very small portion of overall student travel.

##### *Faculty Commuting*

- The number of 1-way trips per week is down by 5% from FY18.

- Mode share of bike commuting is down 5% from FY18.
- The percentage of walking trips is down 17% and continues to be a very small portion of faculty commuting.
- Carpooling mode share is up 13% from FY18 but continues to be a very small portion of trips.
- The number of trips by bus is down 13% from FY18, which breaks a trend of increasing mode share.
- The average trip length is up by 9% from FY18 but remains lower than all other years.
- Same note on average carpool size as student commuters.

#### *Staff Commuting*

- The percentage of staff commuting trips on bikes has decreased by 9% from FY18.
- The percentage of walking trips has decreased by 31% from FY18 but remains a very small portion of trips and within historical range.
- The mode share for carpooling has increased by 13% from FY18 and has overtaken the bus as a higher percentage mode of travel.
- The mode share for the bus has decreased by 24% from FY18 and is the second lowest mode of travel percentage.
- Staff trip distance has increased by 5% and is the farthest distance commuted for staff since tracking of this figure began.
- NOTE: The mode split for staff commuting does not sum to 100%. This has been resolved in a later update
- Same note on average carpool size as student commuters.

#### AIR TRAVEL

- The cost of domestic flights increased 6%, but the average cost per mile decreased 10% from FY18. The total domestic miles increased by 18%, which is slightly higher than the estimate for FY17.
- The cost and miles estimated for international travel have decreased by 10% and 15%, respectively, from FY18, breaking a trend of significant year-over-year increases.
- The overall estimated airline miles traveled is up by 6% from FY18, continuing a trend of increasing airline miles.
- NOTE: The data source for FY19 average cost of domestic and international flights has changed to an MIT source, which has lower costs in past years vs. the inventory tool. The resulting difference in emissions is <1%, so the change does not need to be reflected to the baseline year.

#### WASTE

- The amount of waste produced in FY19 is down by 13% from FY18, which is a sharp decrease compared to the growing student population. A later review provided notes that attributes part of this change to a decreased amount of animal waste
- The amount of waste composted decreased by 41% from FY18 and is the lowest amount of waste composted since FY13. It is noted in a supporting memo that accuracy of tracking compost has increased, which is likely driving the change.
- Recycled waste totals and diversion rate are being tracked separately.

#### RENEWABLE ENERGY CERTIFICATES & OFFSETS

- A significant purchase of RECs in FY19 led to a 39% decrease in electricity emissions.

- Combined with the first purchase of carbon offsets, decreasing electricity emissions by 1% in FY19, the total amount of purchased RECs and offsets reduced electricity emissions by 40% in FY19.
- The additional REC and offset purchases led to an increase of the electricity use offset of 284% in FY19 from FY18.
- Windsource® subscriptions generated 19% less electricity emissions reductions in FY19 than FY18, the lowest since tracking began in FY15.

## Output Review

- **On-campus stationary:** Emissions have increased by 6% from FY17, which is consistent with the increased natural gas/propane/diesel use. The propane emissions factor decreased slightly after an updated EPA emissions factor was used.
- **Direct Transportation:** Emissions have decreased by 8% since FY18, which is consistent with fleet fuel use trends. Fleet gasoline use has decreased by 3% while diesel has decreased 21%, and gasoline makes up 80% of the total fuel use.
- **Refrigerants:** Emissions from refrigerants increased by 1% from FY18 as increases in R-404a were offset mostly by decreases in other refrigerants.
- **Agriculture:** Emissions due to agriculture are up by 6% from FY18. This is not consistent with what was expected. A later review provided resolution to this issue. See tool notes for more details.
- **Electricity:** The emissions are flat (very slight decrease) since FY18, which is consistent with the 2% increase in energy use and 2% decrease in emissions factor. This number does not include REC purchases/offsets.
- **Commuting**
  - Faculty and staff commuting emissions decreased by 10% from FY18. This decrease is inconsistent with the trending in commuting mode to more driving and longer trips. It was found that the commuting mode split does not add to 100% for staff in FY19, FY18, and FY17. This has been resolved in a later update.
  - Student commuting emissions increased by 23% since FY17. This change is within the range expected since the student population increased by 11%, average miles traveled increased 14%, the number of SOV trips increased 8%, and bus trips decreased 16%.
- **Air Travel:** The total emissions from air travel increased by 4% from FY18. This is consistent with an increase in total miles traveled by 6% since FY18 and a shift of international travel to domestic travel, which has a lower per passenger-mile emissions factor.
- **Waste:** The total emissions from waste are down 3% since FY18, which is less than expected since the total waste tonnage decreased by 13% and zero emissions were assumed for composting. A later review provided resolution to this issue. See tool notes.
- **T&D Losses:** There was an 11% decrease in the T&D losses between FY18 and FY19, which is consistent with an 11% decrease in the T&D factor.

## Tool Notes

- **Agriculture Emissions:** Based on summary tabs, the CH<sub>4</sub> emissions from agriculture are down 6,093, and the N<sub>2</sub>O emissions are up 122 kg. Using the GWPs of each gas, the emissions in this category should **decrease** by about 134 MT CO<sub>2</sub>e, but on the CO<sub>2</sub>e output tab the agriculture emissions have **increased** by 441 MT CO<sub>2</sub>e. A follow up note shows that this difference is

attributable to an updated global warming potential figure for methane from the EPA between FY18 and FY19 and is not an issue.

- **Waste:** The emissions on the methane-specific summary tab show a **12%** decrease in methane emissions from waste, but the CO<sub>2</sub>e summary tab shows a **3%** decrease. A follow up note shows that this difference is attributable to an updated global warming potential figure for methane from the EPA between FY18 and FY19 and is not an issue.