St. Thomas' WHITEMARSH

CARBON FOOTPRINT ANALYSIS REPORT

Summary of Greenhouse Gas Emissions from Baseline year 2018

May 07, 2021

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Introduction

- St. Thomas Church campus – buildings and grounds
  - Located in Fort Washington, PA
  - Nine buildings, 69,000 square feet total
- Summary and results of the analysis of greenhouse gas emissions based on all sources of energy used in 2018
- Important terms:
  - Greenhouse Gas (GHG)
    - GHGs are a specific group of gases that when released into Earth's atmosphere cause the increased retention of heat and harm to our environment
    - GHGs are released from the combustion of fuels or other sources such as waste
    - The most typical GHGs are carbon dioxide, methane, and nitrous oxide
  - Carbon Dioxide Equivalent (CO_2e)
    - A metric of emissions with all GHG equated to the proportional carbon dioxide equivalent emission
  - Metric Tons (MT)
    - Metric Ton = 1,000 kg or 2,205 lbs.

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GHG Emissions Quantification Methodologies

- GHG Inventory Reporting Period
  - 2018 base year (2018 was a typical year not impacted by recent public health crisis and before the implementation of energy management measures)
  - Emission reduction from solar based on future projections
- GHG Inventory Reporting Protocol
  - Emissions quantified
    - Stationary combustion (natural gas and oil)
    - Indirect emissions from purchased electricity
    - Mobile combustion from lawn and garden equipment
  - Elements not used in analysis
    - Mobile combustion from employee commuting
    - Emissions from the disposal of waste

Baseline Data

- Energy Usage by Source (2018)

	Electricity (kWh)	Natural Gas (ccf)	Heating Oil (gallon)	Unleaded Gasoline (gallon)
Parish House	197,600	18,817		
Cottage	11,218		744.0	
Groton House	18,808		795	
School House	18,373			
Barn	26,529		1,424.8	
Church	151,280		7,992.2	
Church Hill Hall	30,278		1,726.5	
Corner House	20,770	1,657		
Sign	1,457			
Campus Maintenance				464.3
TOTALS	**476,313**	**20,474**	**12,682.5**	**464.3**

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Emission Factors

	CO_2 factor	CH_4 factor	N_2O Factor	CO_2e factor
Electricity (Source)	lb/MWh	lb/MWh	lb/MWh	lb/MWh
	784.3	0.068	0.01	788.8

Source: EPA eGRID State Output Emission Rates, 2018

	kg CO_2 per scf	g CH_4 per scf	g N_2O per scf
Natural Gas	0.05444	0.00103	0.0001

Source: EPA eGRID Emission Factors, Stationary Combustion, 2018

	kg CO_2 per gallon	g CH_4 per gallon	g N_2O per gallon
Heating Oil (No.2)	10.21	0.41	0.08

Source: EPA eGRID Emission Factors, Stationary Combustion, 2018

	kg CO_2 per gallon	g CH_4 per gallon	g N_2O per gallon
Motor Gasoline	8.78	10.705 *	0.12*

Source: EPA eGRID Emission Factors for Mobile Combustion, 2018

* Lawn and garden equipment, average for 2-stroke and 4-stroke engines

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Emissions by Source

Emissions from Stationary Combustion (metric tons)

Source	CO2	CH4	N2O	CO2e
Natural Gas	111.46	0.0021	0.0002	**111.6**
Heating Oil	129.49	0.0052	0.0010	**129.9**

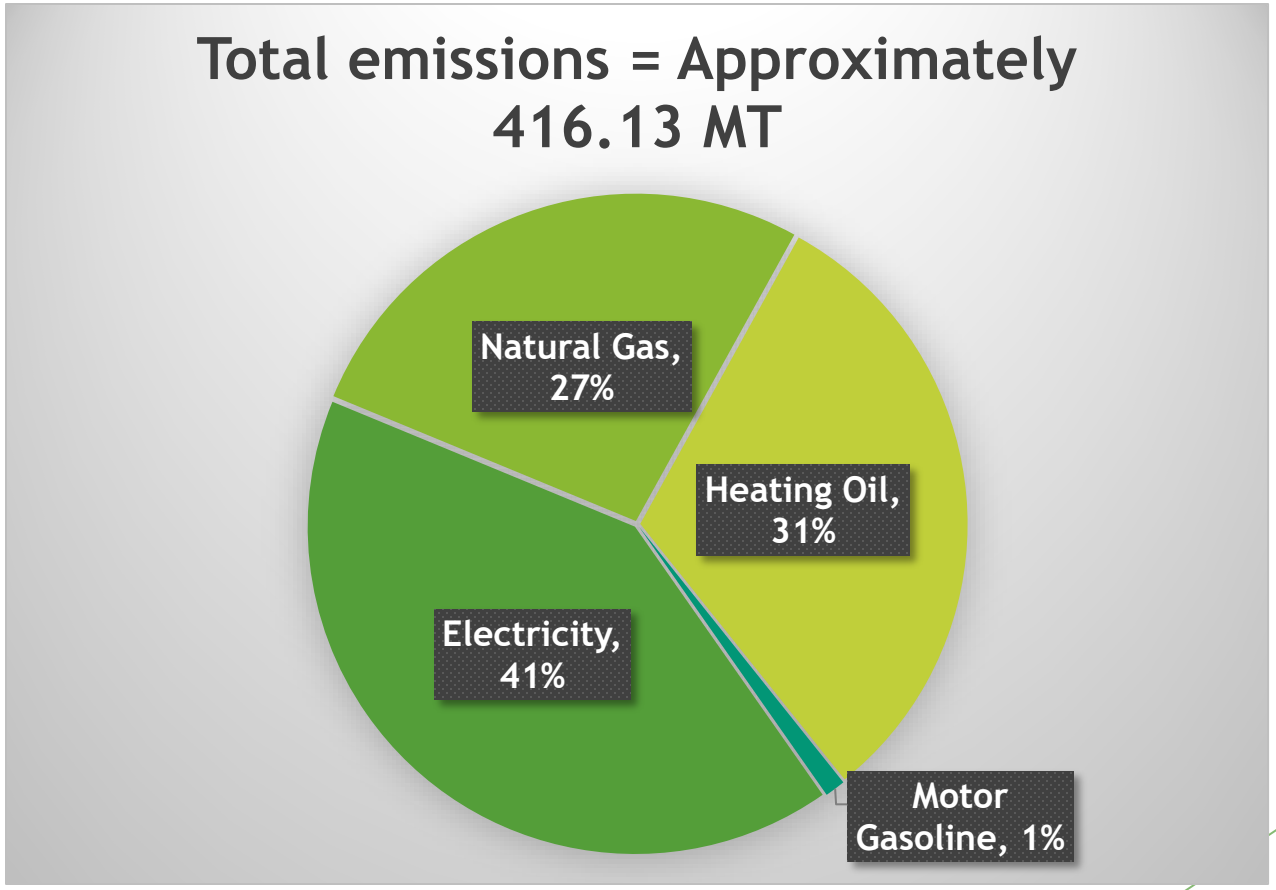
Indirect Emissions from Electricity (metric tons)

Source	CO2	CH4	N2O	CO2e
Electricity	169.45	0.015	0.002	**170.42**

Emissions from Mobile Combustion (metric tons)

Source	CO2	CH4	N2O	CO2e
Gasoline	4.08	0.1358	0.0015	**4.21**

Total Calculated Emissions



GHG Emission Offsets from Solar Energy

- Assessed annual energy generation estimates provided by solar project developer from the HelioScope solar production estimation tool
- Emission reduction based on new solar project in Metric Tons

CO_2	CH_4	N_2O	CO_2e
149.40	0.013	0.0019	**150.25**

- 150.25 MT of CO_2e reduction from solar equals:
  - Approximately 36% of the total emissions and
  - Approximately 88% of emissions from electricity usage

Conclusion: Nearly There

- **St. Thomas is already well on the way to achieving the 50% carbon emissions reduction goal with the solar**
- Total CO2e emissions are approximately 416 MT CO2e, roughly equivalent to the annual emissions from 50 typical, American homes
- Total CO2e emissions reduction from on-site solar – 150 MT CO2e
- Percent Reduction of total CO2e emissions from solar – 36.1%
- These results are a point of time measurement and should be used as a comparison for future emissions
- Future carbon footprint analyses should use similar methodology and take into account changes in use, equipment, as well as other location specific considerations

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Recommendations and Further Findings

- We recommend converting facilities and equipment that operate on heating oil to natural gas, ductless variable refrigerant flow systems, or electric heat
- It is possible to further reduce on-site gasoline usage by considering electric vehicles and electricity powered landscaping equipment replacements when appropriate
- It is possible to further reduce emissions related to electricity usage by continuing with energy efficiency improvements such as cooling system equipment upgrades, fan motor controls, building management system optimization, and plug load management
- We found no obvious change in electricity usage year over year that could be attributed to any single energy efficiency improvement

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Memorandum

TO: File with March 2021 Carbon Footprint Analysis Report by Gabel Associates
FROM: Jim Pasquarella, Brookes Britcher
CC: Tamika Gerhardt, Parish Administrator
SUBJECT: Allocation of 2018 Oil Consumption in Church Sanctuary and Groton House
DATE: 22 March 2021

Equipment: The Church is served by three systems, as follows:

- East end of the Church (toward Church Hill Hall) is served by a 500,000 btu heater (120,000 btu AC). The oil is supplied from the easterly 1,000-gal tank, that also supplies the heater at Groton House. The thermostat is in the front of the church on the North wall.
- West end of the Church is served by a 687,000 btu heater (180,000 btu AC) supplied from the westerly 1,000-gallon tank. The thermostat is in the rear of the church on the South wall.
- Haas Hall (c. 2001 expansion), attached to the Church, is served by a roof-mounted 145,000 btu electric heat (120,000 btu AC). This system is electric-only.

Oil Supply: Brookes has spoken with Derek at SELF OIL/MOYER OIL and verified that our accounts serving the Church building and Groton House map to two (2) 1,000-gallon underground storage tanks referenced above:

- Account 1005 is labeled as "Church." It is a 1,000-gallon tank feeding only the Church.
- Account 1007 is labeled as "Groton House." It is a 1,000-gallon tank feeding the Church & Groton House.

Inconsistency Noted: We note that our accounting files for oil deliveries in 2018 are inconsistent with 2018 reports supplied by SELF Oil in March 2021. Whereas our internal records reflect 8,787.2 gallons for Groton House & Church delivered during 2018 (*including one delivery on 1/2/2019*), SELF's reports indicate that 2018 deliveries totaled 9,673.6 gallons. This inconsistency extends to all oil accounts on campus, whereas our internal accounting reflects 12,682.50 gallons, and SELF's reports indicates 14,465.9 gallons. **This overall variance of 14% should be further explored.**

Allocation of Oil Consumption on Account 1007 between Church and Groton House:
In connection with Gabel Associates' pending carbon footprint analysis, St. Thomas' seeks to allocate the amount of oil utilized in 2018 (which Gabel selected as its base year) for heating the Church building and heating Groton House.

We allocate the 2018 oil consumption at these two buildings as follows. Oil consumption of 0.96 gallons/hr was determined from the burner specification sheet at 125psi and the burner nozzle size from the burner name plate information on the equipment in Groton House. Using 140,000 btu/gal for the specific heat of #2 heating oil yields an estimated capacity of 133,000 btu/hr (140,000 x 0.95). Multiplying 133,000 btu/hr by the 5.975 gal/1000 btu from above yields an estimated **2018 Groton House oil consumption of 795 gallons. Therefore, the estimated 2018 Church building oil consumption was 7,992.2 gallons.**