

Dartmouth College Greenhouse Gas Report

FISCAL YEAR 2018



DARTMOUTH
Sustainability Office

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Greenhouse Gas Report

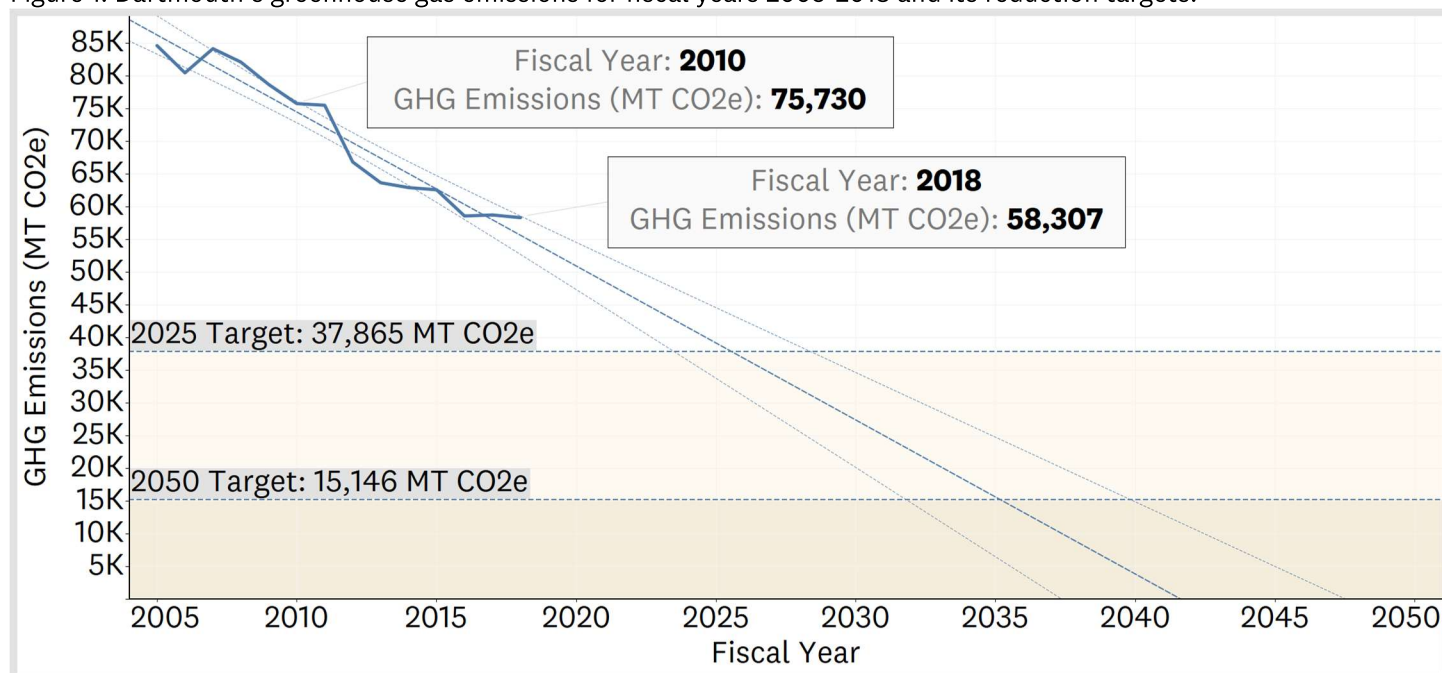
Summary

Dartmouth College utilizes many resources that result in the production of direct (Scope 1) or indirect (Scope 2) greenhouse gas emissions that contribute to climate change. This report covers Scope 1 and 2 emissions associated with the College's operations between fiscal year (FY) 2005 and 2018. All reported data are in fiscal year unless specified. Dartmouth's fiscal year runs from July 1-June 30 of each year; for example, FY18 was July 1, 2017-June 30, 2018. We report greenhouse gas emissions in metric tons of carbon dioxide equivalent (MT CO₂e), a unit that allows for comparison of different emissions, as scaled by each gas' warming potential. We use an operational control boundary to account for Scope 1 and 2 emissions in this report; Scope 3 emissions are not included in this report.

Dartmouth adopted new greenhouse gas reduction targets in 2017 with the [Our Green Future Report](#) that utilizes our 2010 greenhouse gas emissions as our baseline for reduction. We estimate that our 2010 emissions were 75.7 MT CO₂e (Fig. 1). The Our Green Future has a 2025 target of a 50% reduction and a 2050 target of an 80% reduction compared to our 2010 baseline. We estimate that our 2025 target is 37,865 MT CO₂e and our 2050 target is 15,146 MT CO₂e based on our 2010 estimates (Fig. 1). The College aspires to a carbon negative energy system starting in 2051.

Dartmouth College produced 58.3K MT CO₂e in 2018, a reduction of 17.4K MT CO₂e or 23% since 2010, when the College produced 75.7K MT CO₂e (Fig. 1). Dartmouth's emissions have significantly ($p < 0.0001$) decreased at a rate of 2355 MT CO₂e per year between 2005 and 2018. Dartmouth's 2025 target is 37.9K MT CO₂e and its 2050 target is 15.1K MT CO₂e given our estimation of 2010 emissions. Dartmouth is on track to meet its 2025 targets, if the current trend in greenhouse gas emissions continues.

Figure 1. Dartmouth's greenhouse gas emissions for fiscal years 2005-2018 and its reduction targets.



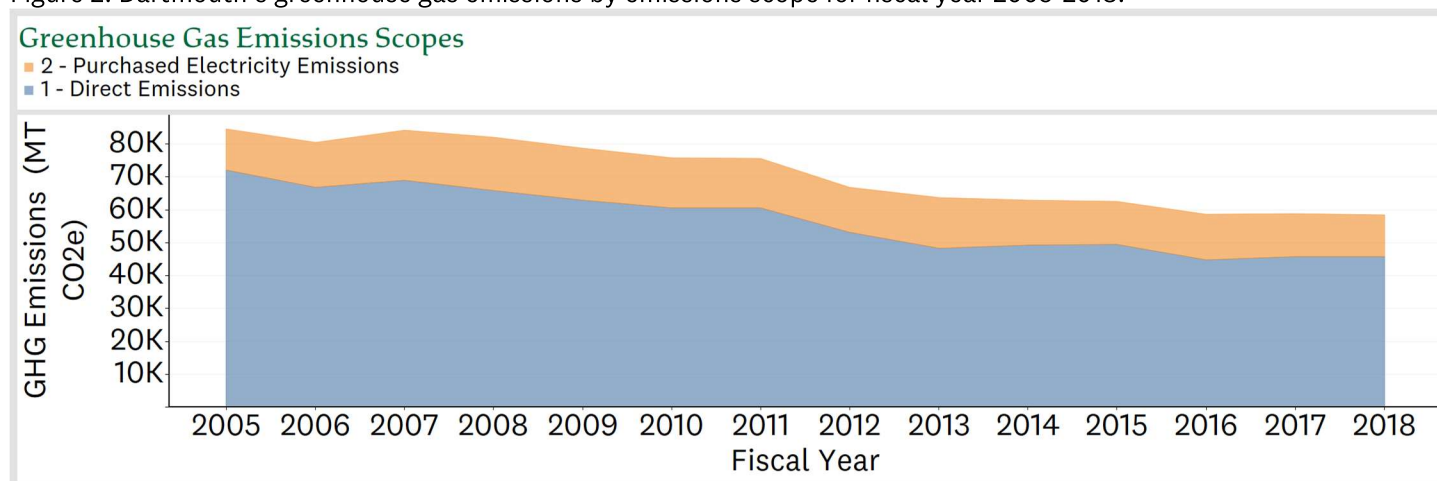
Greenhouse gas emissions by scope

Dartmouth's Scope 1 emissions are associated with direct usage from sources that the College owns and controls. At Dartmouth, this includes combustion of liquid fuels at the Central Energy Plant, use of other liquid fuels for heating and transportation systems on campus, fertilizers for the grounds, horses for the

equestrian program, and refrigerants for heating and cooling systems and refrigerators. Dartmouth's Scope 2 emissions are those associated with purchasing electricity from Liberty Utilities through the local electricity grid.

Dartmouth's Scope 1 emissions have been consistently larger than the College's scope 2 emissions between 2005 and 2018 (Fig. 2). Dartmouth's Scope 1 emissions have decline significantly ($p < 0.0001$) by 2238 MTCO₂e annually since 2005, whereas Scope 2 emissions have not changed significantly since 2005.

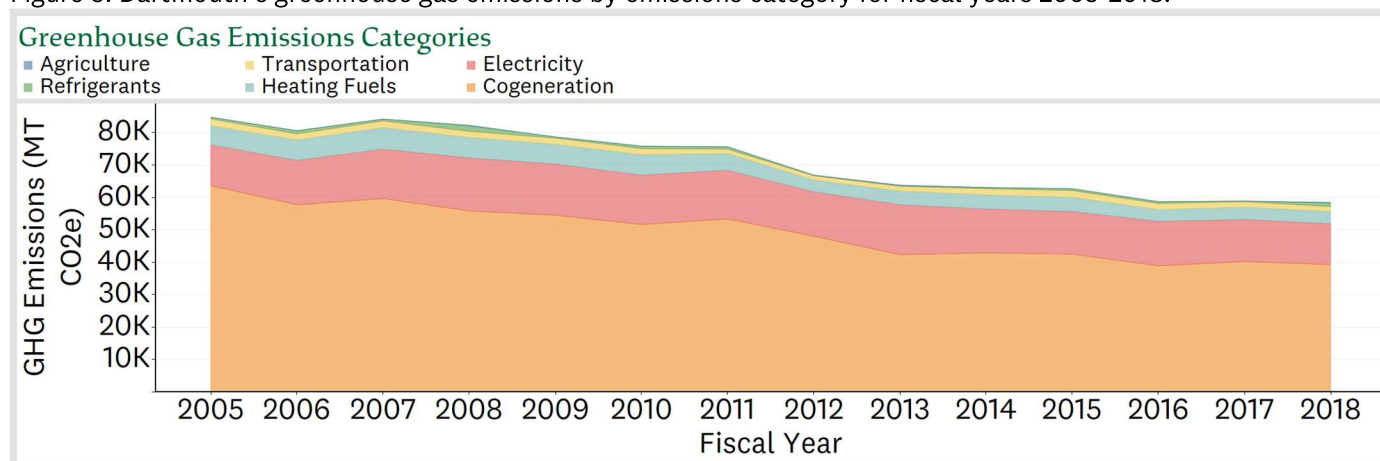
Figure 2. Dartmouth's greenhouse gas emissions by emissions scope for fiscal year 2005-2018.



Greenhouse gas emissions by emissions category

Dartmouth's Scope 1 emissions decrease is primarily attributable to the significant decrease ($p < 0.0001$) of 1940 MT CO₂e/year in cogeneration at the Central Energy Plant (Fig. 3). The College's other emissions categories, other heating fuels (i.e., propane and #2 fuel oil), transportation (gas and diesel), refrigerants, agriculture, and electricity (Scope 2), together sum to less than half of the emissions produced by cogeneration stationary combustion alone as of 2018.

Figure 3. Dartmouth's greenhouse gas emissions by emissions category for fiscal years 2005-2018.



Dartmouth's greenhouse gas emissions categories have varied in their trends since 2005; emissions from the cogeneration plant and heating fuels on campus have exhibited significant declines, while the other four emissions categories have not significantly changed (Table 1).

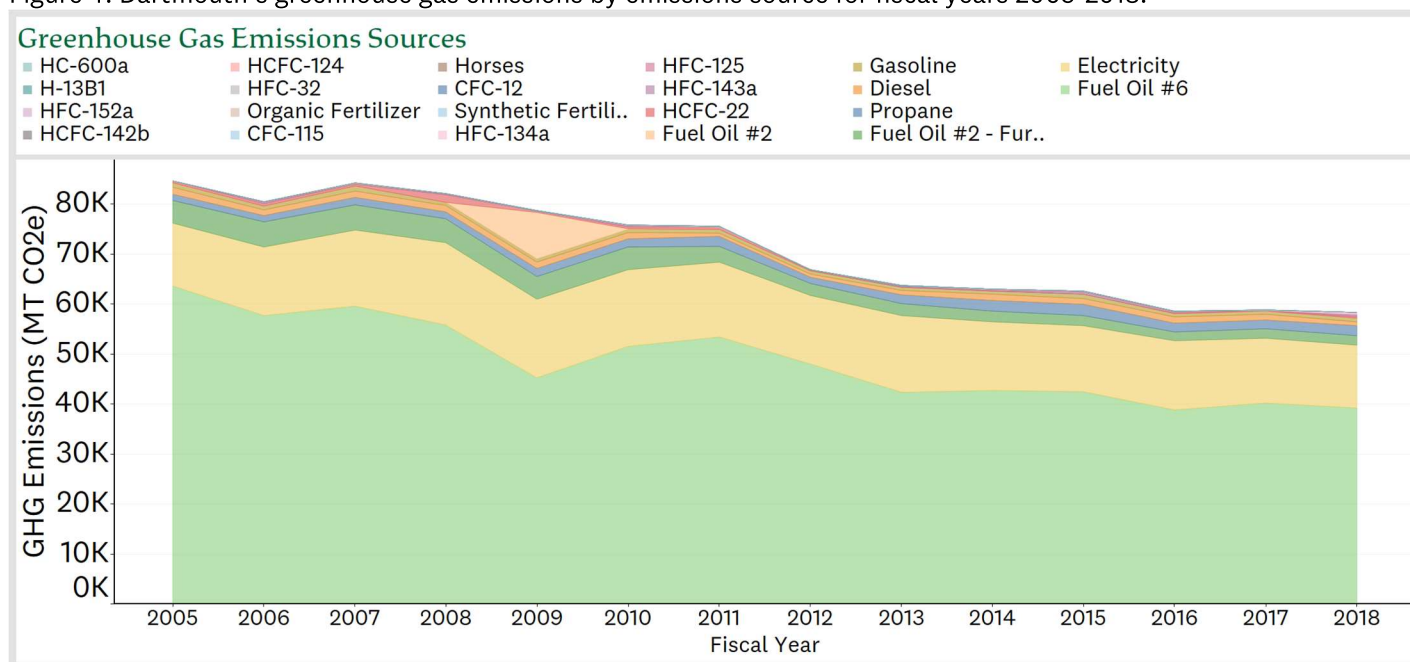
Emissions Categories	Rate (MTCO ₂ e/year)	Confidence (p)
Cogeneration	-1940	<0.0001
Electricity	-117	0.17
Other Heating Fuels	-247	<0.0001
Transportation Fuels	-28	0.14
Refrigerants	-23	0.43
Agriculture	0.48	0.51
Total	2,355	

Table 1. Emissions sources categories linear rate of change between FY05-18 and associated p values (p-values less than 0.05 are traditionally considered significant). Only cogeneration and other stationary combustion show a significant linearly decreasing trend, and cogeneration is decreasing at more than seven times the rate of other stationary combustion.

Greenhouse gas emissions by emissions source

Dartmouth's combustion of #6 fuel oil in the Central Energy Plant and purchase of electricity from the grid are responsible for 67% and 22%, or 89% combined, of the College's emissions respectively (Fig. 4, Table 2 for details). Heating the College's buildings not connected to the Central Energy Plant with propane and #2 fuel oil each contribute 3% of the College's 2018 emissions (Fig. 4, Table 2 for details). These four sources of emissions were responsible for 95% of the College's emissions in 2018. The College's transportation fuels, gasoline and diesel, refrigerants (7 types were used in 2018), and agricultural practices account for the remaining 5% (Table 2 for details).

Figure 4. Dartmouth's greenhouse gas emissions by emissions source for fiscal years 2005-2018.



Conclusion

Though Dartmouth's fiscal year 2018 emissions are in line with its 2017 targets, we need to curtail emissions much faster to meet future targets. Reductions in emissions to date have mostly been driven by purchasing less carbon-intensive electricity from the local grid and increasing energy efficiency on campus. The announced transition to a new biomass heating plant and hot water distribution system in January 2019 will significantly decrease our emissions and put us on track to achieving these targets.

Emissions Scope	Emissions Category	Emissions Source	FY05 Emissions	FY18 Emissions	Change (FY05-FY18)	% Change	Rate (MT CO2e/year, if significant trend)	Confidence (p-value)
1	Cogeneration	#6 Fuel Oil	63.6	39.1	24.2	38%	-1837	p<0.0001
1	Cogeneration	#2 Fuel Oil						
1	Other Heating Fuels	#2 Fuel Oil – Furnaces	4.6	1.9	2.7	59%	-306	p<0.0001
1	Other Heating Fuels	Propane	1.2	1.9	-.7	-58%	59	p<0.002
1	Transportation Fuels	Diesel	1.3	0.8	0.5	38%		
1	Transportation Fuels	Gasoline	0.9	0.8	0.1	11%		
1	Refrigerants	HCFC-22	0.4	0.2	0.2	50%	-53	p<0.03
2	Purchased Electricity	Electricity	12.5	12.6	-0.1	-1%		

Table 2. Dartmouth's greenhouse gas emissions by source in thousands of metric tons of carbon dioxide equivalent between 2005 and 2018. Number 2 fuel oil emissions are excluded because insignificant amounts have been used in the Central Energy Plant in FY09-10, 13, and 15; no #2 fuel oil has been used in the last three fiscal years. Refrigerants other than HCFC-22 are not included in this table because they have been used sporadically between FY05 and FY18 and contribute very little to Dartmouth's emissions. Agricultural emissions from fertilizers and horses are also excluded because they contribute so little to the College's emissions footprint.