



**UNIVERSITY OF MICHIGAN – ANN ARBOR
SUSTAINABILITY GOAL REPORTING GUIDELINES**

GOAL #1

REDUCE SCOPE 1&2 GREENHOUSE GAS EMISSIONS BY 25%

SECTION 1: Introduction

As an institution comprised of nearly 400 buildings covering over 37 million square feet, the University of Michigan (U-M) requires a significant amount of energy to meet the educational, research, and operational needs of the campus. An innovational leader, U-M strives to set the standards for sustainability, both in the classroom and through its physical operations. Announced in the fall of 2011, U-M aims to reduce its scope 1 and 2 greenhouse gas emissions from FY2006 levels by 25% by 2025. Achieving a goal such as this will require the development of new technology, improvement of existing technology, and behavioral changes within the University community.

This goal emerges as part of U-M's six sustainability goals for 2025, as announced by President Mary Sue Coleman in 2011. The goals fall under one of four themes: climate action, waste prevention, healthy environments, and community awareness. Each goal will be periodically reevaluated and may be adjusted based on variables such as changes in technology, the State of Michigan energy platform, economics, and peer university goals.

SECTION 2: Emissions Overview

Greenhouse gas (GHG) emissions are a direct result of burning fossil fuels to generate energy. At U-M, the Central Power Plant (CPP) provides energy in the form of steam and electricity to the Medical Center and Central Campus by burning natural gas. Outlying boilers, also fueled with natural gas, provide steam and hot water to more than 100 buildings not serviced by the CPP. The natural gas fueled North Campus Research Complex (NCRC) Central Energy Plant provides steam, chilled water and electricity to the 2.7 million square feet NCRC campus.

SECTION 3: Emission Calculations

The total emissions calculations have been determined by combining scope 1 and 2 emissions. Scope 1 emissions include any stationary and mobile source emissions, while scope 2 refers to emissions related to purchased electricity.

Stationary source emissions have been calculated from information provided by U-M Utilities Summary of Annual Utilities Purchases, and incorporates CO₂, CH₄, and N₂O emissions associated with the combustion of natural gas, fuel oil, and liquefied petroleum (LP) gas.

TABLE 1: Stationary Source Emission Conversion Factors

Fuel Source	Carbon Dioxide (CO ₂)			Methane (CH ₄)			Nitrous Oxide (N ₂ O)		
	Conversion Factor	MT/ccf	Global Warming Potential	Conversion Factor	MT/ccf	Global Warming Potential	Conversion Factor	MT/ccf	Global Warming Potential
Natural Gas (ccf)	0.00545	MT/ccf	1	5.43E-07	MT/ccf	21	1.09E-08	MT/ccf	310
Fuel Oil (gal)	0.01020	MT/gal	1	1.583E-06	MT/gal	21	5.456E-08	MT/gal	310
LP Gas (gal)	0.00540	MT/gal	1	9.093E-07	MT/gal	21	9.495E-08	MT/gal	310

Stationary Source Emissions =

$$\begin{aligned}
 & \text{Natural Gas Purchase (ccf)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Natural Gas Purchase (ccf)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Natural Gas Purchase (ccf)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{Fuel Oil Purchase (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Fuel Oil Purchase (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Fuel Oil Purchase (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{LP Gas Purchase (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{LP Gas Purchase (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{LP Gas Purchase (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential}
 \end{aligned}$$

Mobile source emissions are calculated from information provided by U-M Logistics, Transportation and Parking, which accounts for emissions generated by the combustion of unleaded gasoline, diesel, B-20 and B-5 biodiesel, and E-85 and E-70 ethanol used to fuel U-M's transportation fleet. Note that B-20 is a mixture consisting of 20% biodiesel and 80% diesel, B-5 is a mixture consisting of 5% biodiesel and 95% diesel while E-85 is a mixture of 85% ethanol, and 15% unleaded gasoline and E-70 is a mixture of 70% ethanol, and 30% unleaded gasoline. Conversion factors below refer to the specific fraction of the fuel mixtures.

TABLE 2: Mobile Source Emission Conversion Factors

Fuel Source	Carbon Dioxide (CO ₂)			Methane (CH ₄)			Nitrous Oxide (N ₂ O)		
	Conversion Factor		Global Warming Potential	Conversion Factor		Global Warming Potential	Conversion Factor		Global Warming Potential
Unleaded Fuel (gal)	0.00879	MT/gal	1	1.74E-06	MT/gal	21	5.994E-07	MT/gal	310
Diesel Fuel (gal)	0.01008	MT/gal	1	5.67E-07	MT/gal	21	2.57E-07	MT/gal	310
Biodiesel (gal)	0.00929	MT/gal	1	5.67E-07	MT/gal	21	2.57E-07	MT/gal	310
ULS Diesel (gal)	0.01008	MT/gal	1	5.67E-07	MT/gal	21	2.57E-07	MT/gal	310
Ethanol (gal)	0.00550	MT/gal	1	1.88E-06	MT/gal	21	6.27E-07	MT/gal	310

Mobile Source Emissions =

$$\begin{aligned}
 & \text{Unleaded Fuel (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Unleaded Fuel (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Unleaded Fuel (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{Diesel fuel (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Diesel fuel (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Diesel fuel (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{ULS Diesel (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{ULS Diesel (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{ULS Diesel (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{Biodiesel (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Biodiesel (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Biodiesel (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \\
 & + \text{Ethanol (gal)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\
 & + \text{Ethanol (gal)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\
 & + \text{Ethanol (gal)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential}
 \end{aligned}$$

Scope 2 emissions are calculated from information provided by the U-M Utilities Summary of Annual Utilities Purchases. Conversion factors are determined annually based upon information from the U-M electricity provider.

TABLE 3: Scope 2 Emission Conversion Factors

Fuel Source	Carbon Dioxide (CO ₂)			Methane (CH ₄)			Nitrous Oxide (N ₂ O)		
	Conversion Factor (2018)		Global Warming Potential	Conversion Factor		Global Warming Potential	Conversion Factor		Global Warming Potential
Purchased Electricity (kWh)	0.00068	MT/kWh	1	7.21E-09	MT/kWh	21	1.234E-08	MT/kWh	310

Scope 2 Emissions =

$$\begin{aligned} & \text{Purchased Electricity (kWh)} * \text{CO}_2 \text{ Conversion Factor} * \text{CO}_2 \text{ Global Warming Potential} \\ & + \text{Purchased Electricity (kWh)} * \text{CH}_4 \text{ Conversion Factor} * \text{CH}_4 \text{ Global Warming Potential} \\ & + \text{Purchased Electricity (kWh)} * \text{N}_2\text{O Conversion Factor} * \text{N}_2\text{O Global Warming Potential} \end{aligned}$$

SECTION 4: Goal Reporting

The 2006 baseline for this 2025 goal is 680,000 MTCO₂e. FY2006-FY2011 emissions have been adjusted in an effort to include University expansion at NCRC. An estimate of 60,000 MTCO₂e is based upon data provided by the previous owner of the facility. Calculations were completed using the following equations:

FY2006 baseline:

$$\begin{aligned} & \text{Emissions as reported in the U-M Annual Sustainability Report (ASR)} + \text{NCRC adjustment} \\ & = 620,000 + 60,000 = 680,000 \text{ MTCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{FY2007} & = \text{ASR} + \text{NCRC adjustment} \\ & = 600,000 + 60,000 = 660,000 \text{ MTCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{FY2008} & = \text{ASR} + \text{NCRC adjustment} \\ & = 615,000 + 60,000 = 675,000 \text{ MTCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{FY2009} & = \text{ASR} + \text{NCRC adjustment} \\ & = 592,000 + 60,000 = 652,000 \text{ MTCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{FY2010} & = \text{ASR} + \text{NCRC adjustment} - \text{NCRC emissions associated with partial activity} \\ & = 672,000 + 60,000 - 41,000 = 690,000 \text{ MTCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{FY2011} & = \text{ASR} + \text{NCRC adjustment} - \text{NCRC emissions associated with partial activity} \\ & = 722,000 + 60,000 - 51,000 = 730,000 \text{ MTCO}_2\text{e} \end{aligned}$$

FY2012 (and future) = ASR reported value (NCRC relocations will be assumed to be completed)

To achieve this goal U-M must reduce greenhouse gas emissions to 510,000MTCO₂e/year.

Continued monitoring of the goal status will be conducted annually and reported through the University of Michigan Annual Sustainability Report and will be available to the public via the Office of Campus Sustainability web site: <http://sustainability.umich.edu/ocs/metrics>.