Grand Rapids

Preliminary Building Stock Assessment

version: 2019.07.01

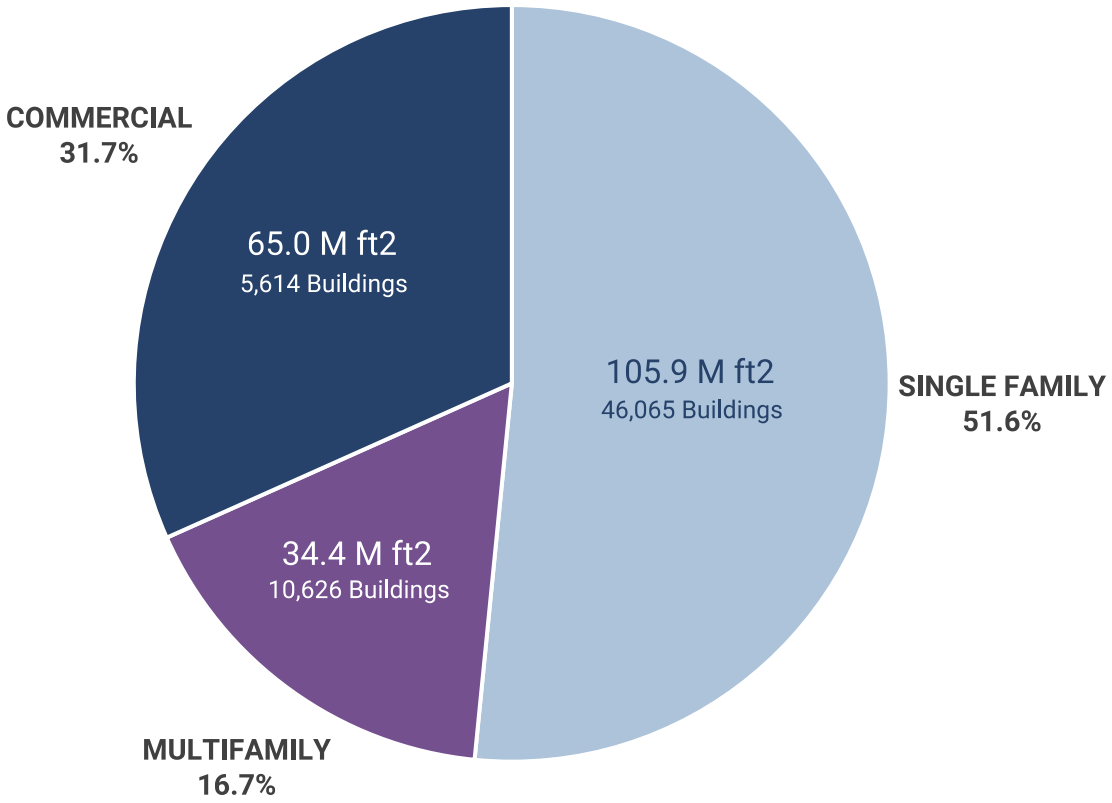
This building stock assessment consists of baseline and future projections of energy consumption, greenhouse gas emissions, and fuel types by building type and size, and includes information about historic “building intervention rates” such as sale transaction rates and renovation rates by major building types and size. The intents of the assessment are to (1) inform and direct future Zero Cities project work, (2) create a tool for analyzing the likely greenhouse gas emissions and energy impacts of the policies and strategies developed through Zero Cities project work, and (3) create a set of common metrics between Zero Cities project participants (eleven cities in total).

BUILDING STOCK BASELINE ANALYSIS

BUILDING AREA SUMMARY

GRAND RAPIDS, MI

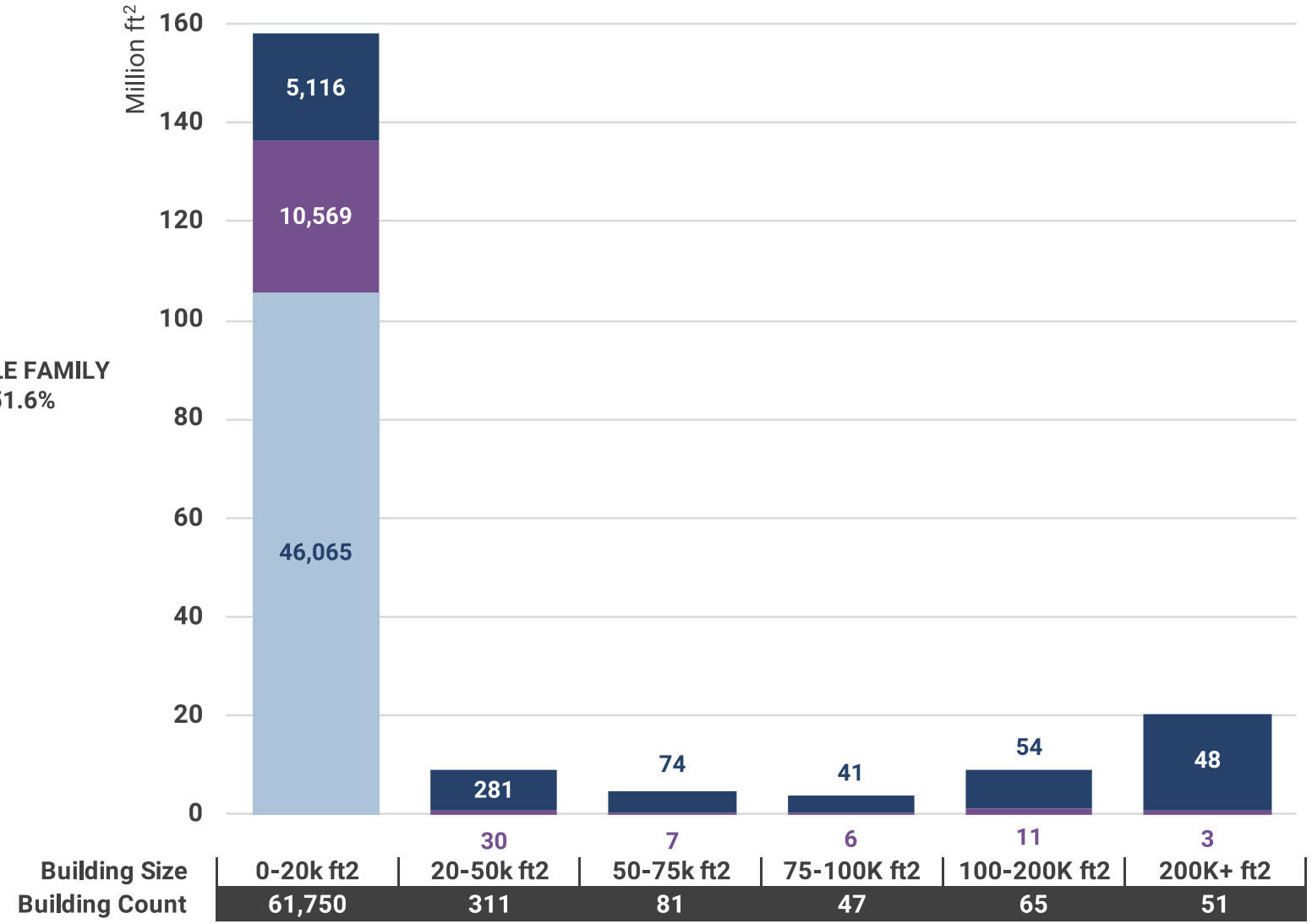
Current Building Area by Type



Current Building Stock

205,265,759 square feet
62,305 buildings

Current Building Area by Size



BUILDING AREA SUMMARY

GRAND RAPIDS, MI

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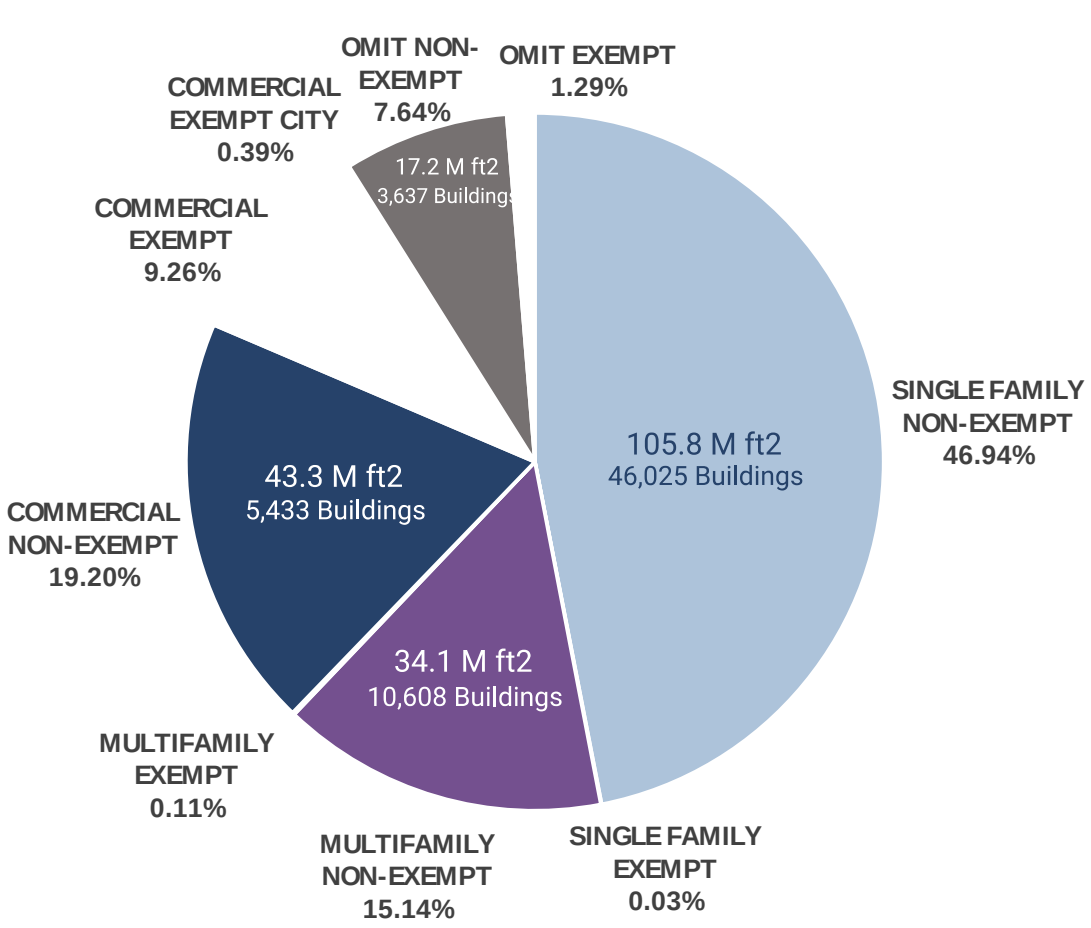
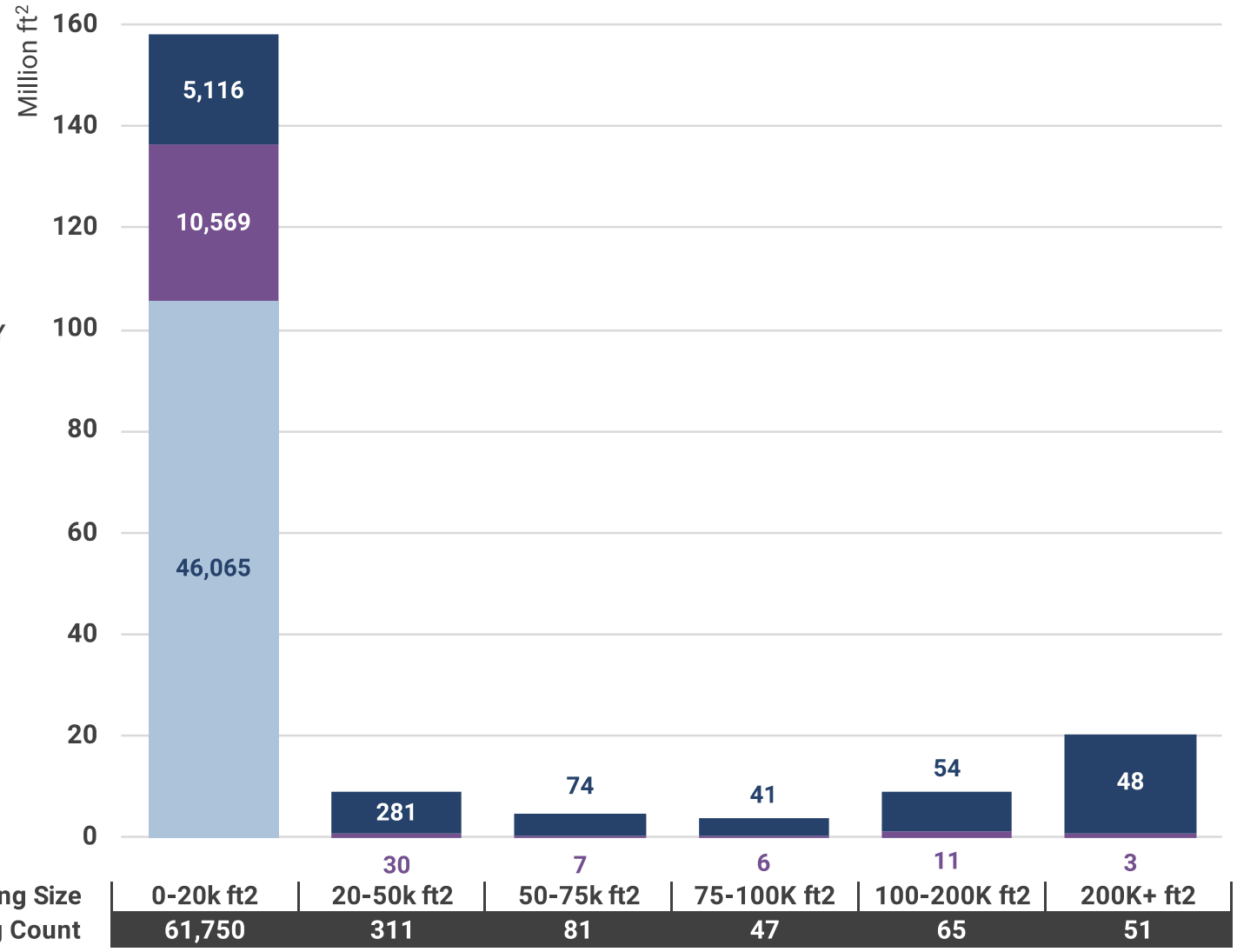


Current Building Stock

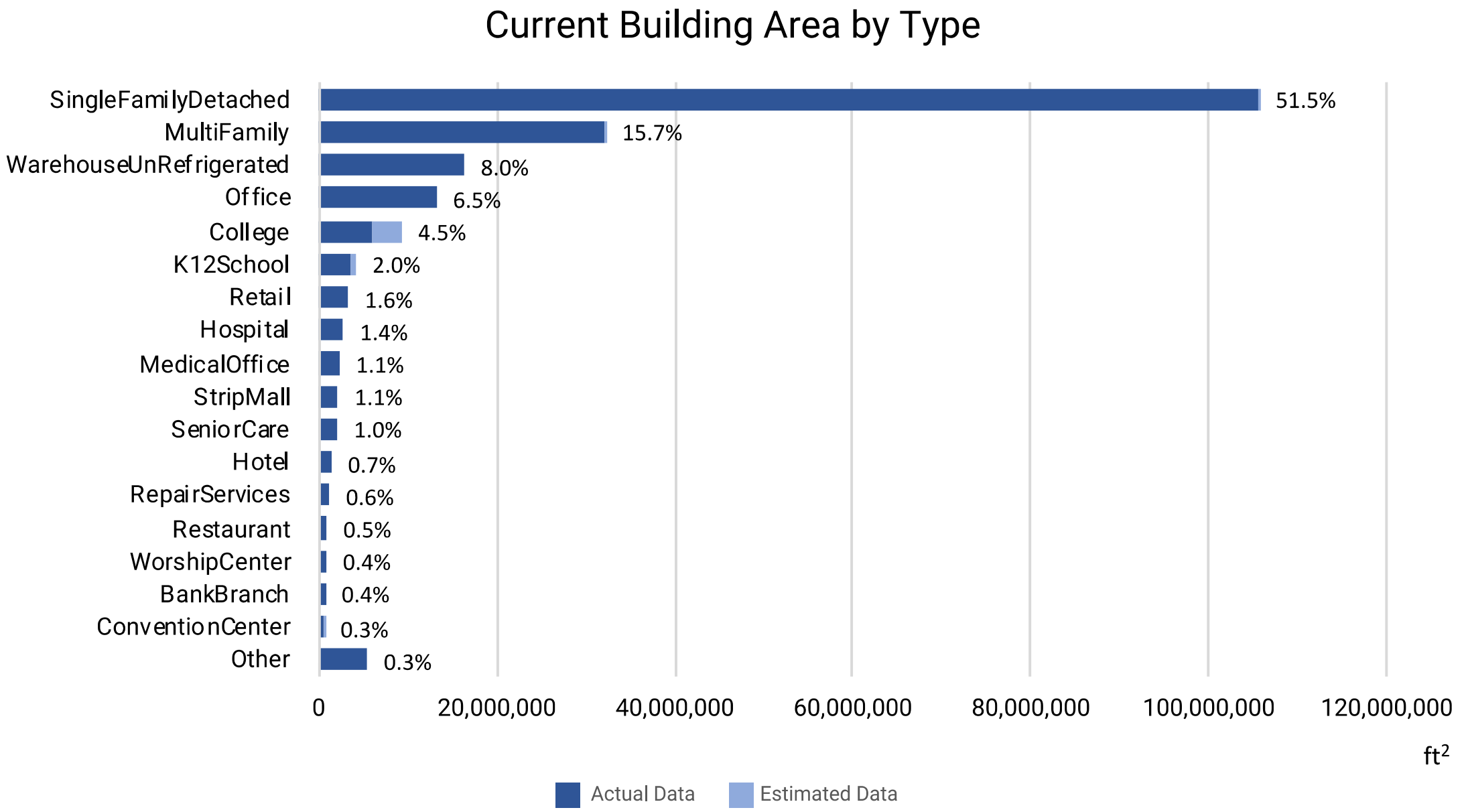
225,388,437 square feet
66,263 buildings

Current Building Area by Size



BUILDING AREA SUMMARY

GRAND RAPIDS, MI



METHODOLOGY

1. Used City of Grand Rapids Assessor Data to determine use type and floor area for non-tax exempt properties.
2. Used data provided by the city to determine use type and floor area for tax exempt properties.
3. Matched city use types to Zero Tool use types.
4. Applied average floor areas based on both data sets to properties without floor area information.

QUESTIONS

ASSUMPTIONS

1. Tax exempt properties with “0” floor area omitted
2. Single Family Residential properties over 5,000 ft^2 are actually Multifamily

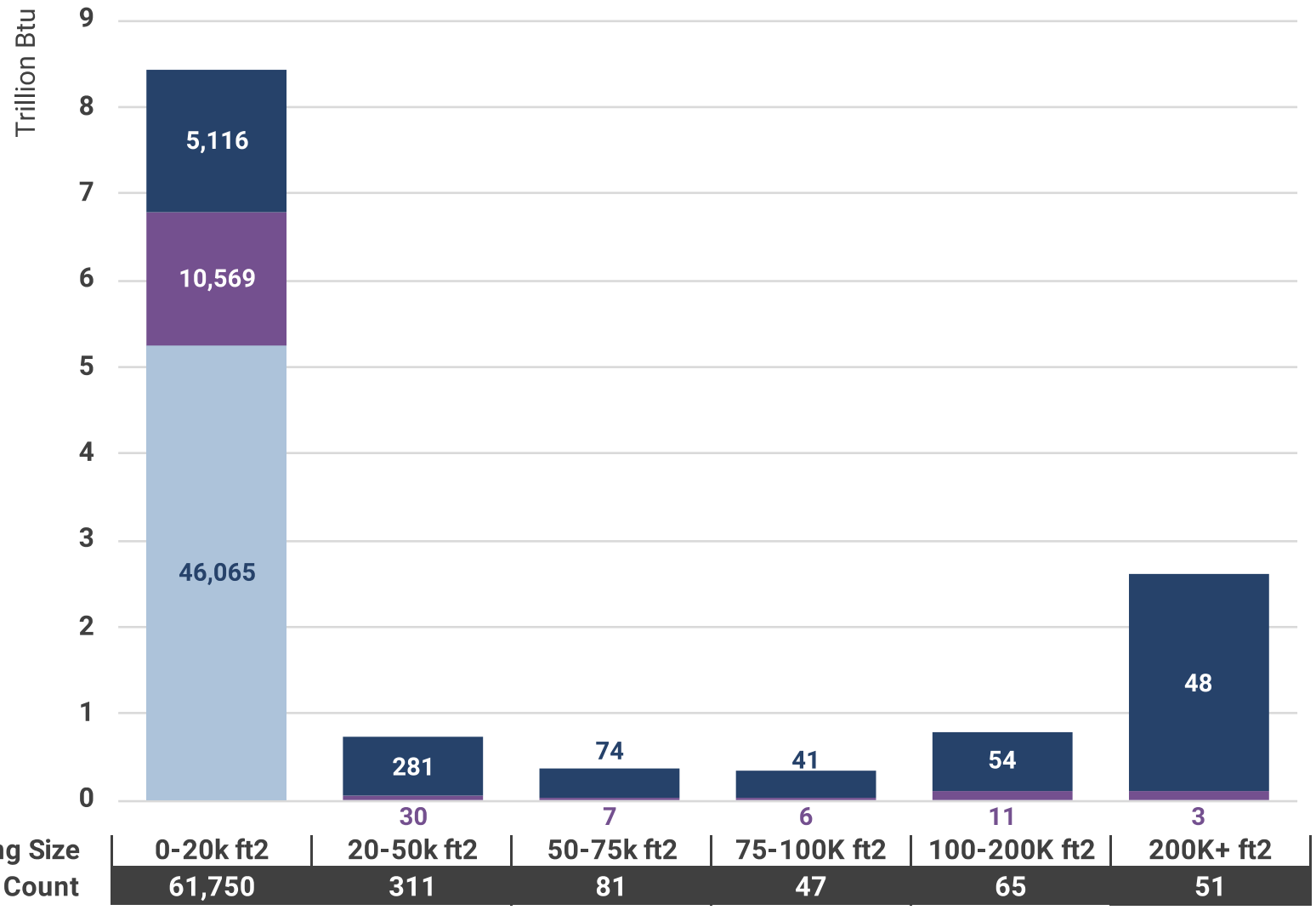
DATA SOURCES

1. City of Grand Rapids Assessor Data
2. Tax Exempt Property Data provided by Alison and Mike from the city

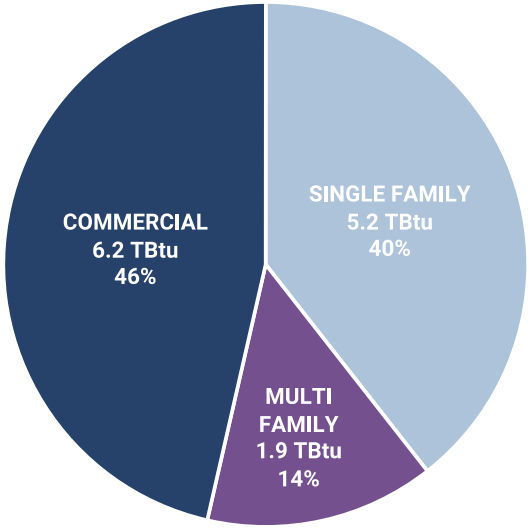
BUILDING ENERGY USE SUMMARY

GRAND RAPIDS, MI

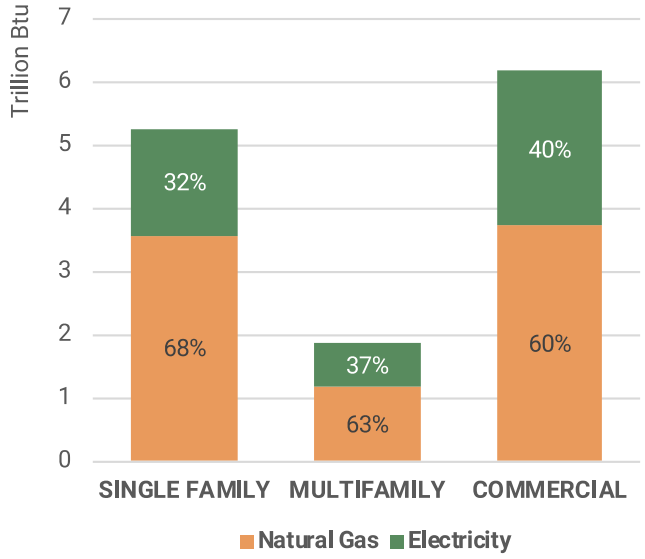
Current Building Energy Consumption by Size



Current Building Energy Consumption by Type



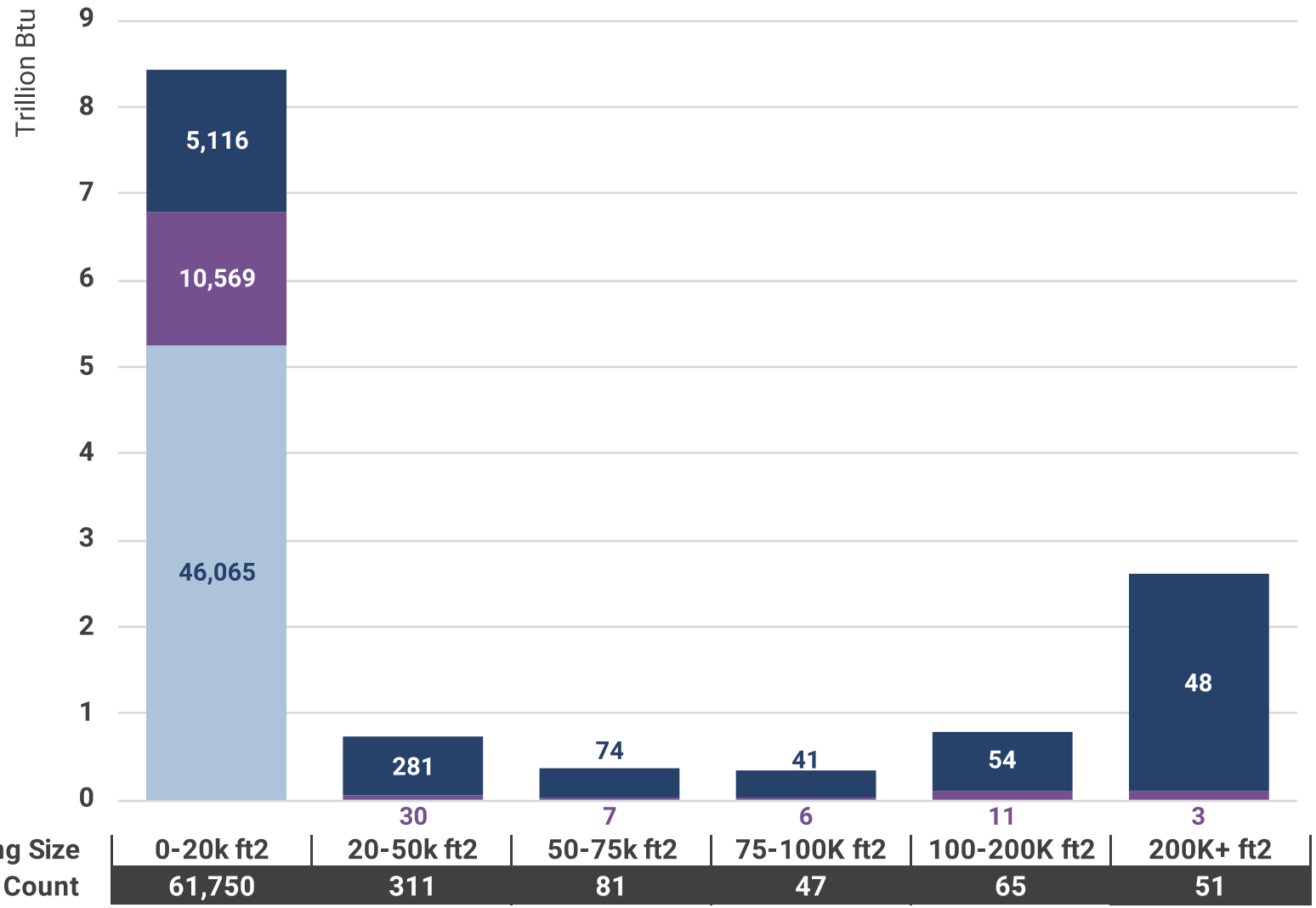
Current Building Energy Consumption by Fuel & Type



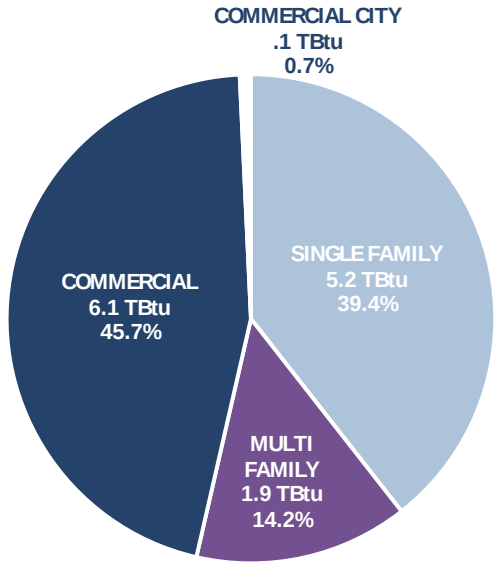
BUILDING ENERGY USE SUMMARY

GRAND RAPIDS, MI

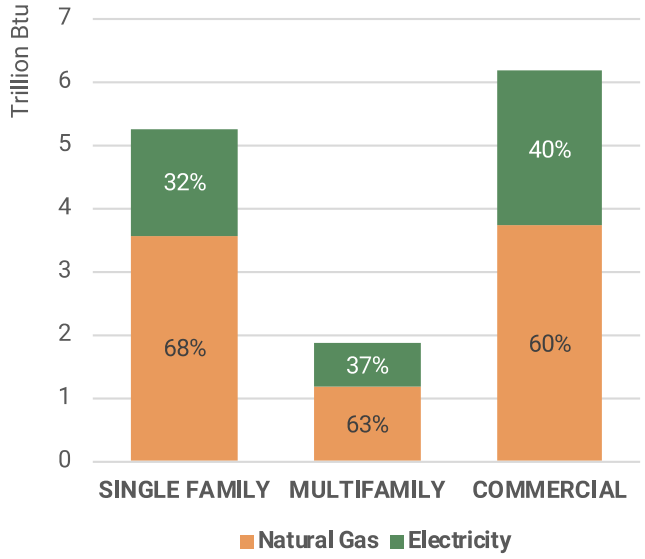
Current Building Energy Consumption by Size



Current Building Energy Consumption by Type

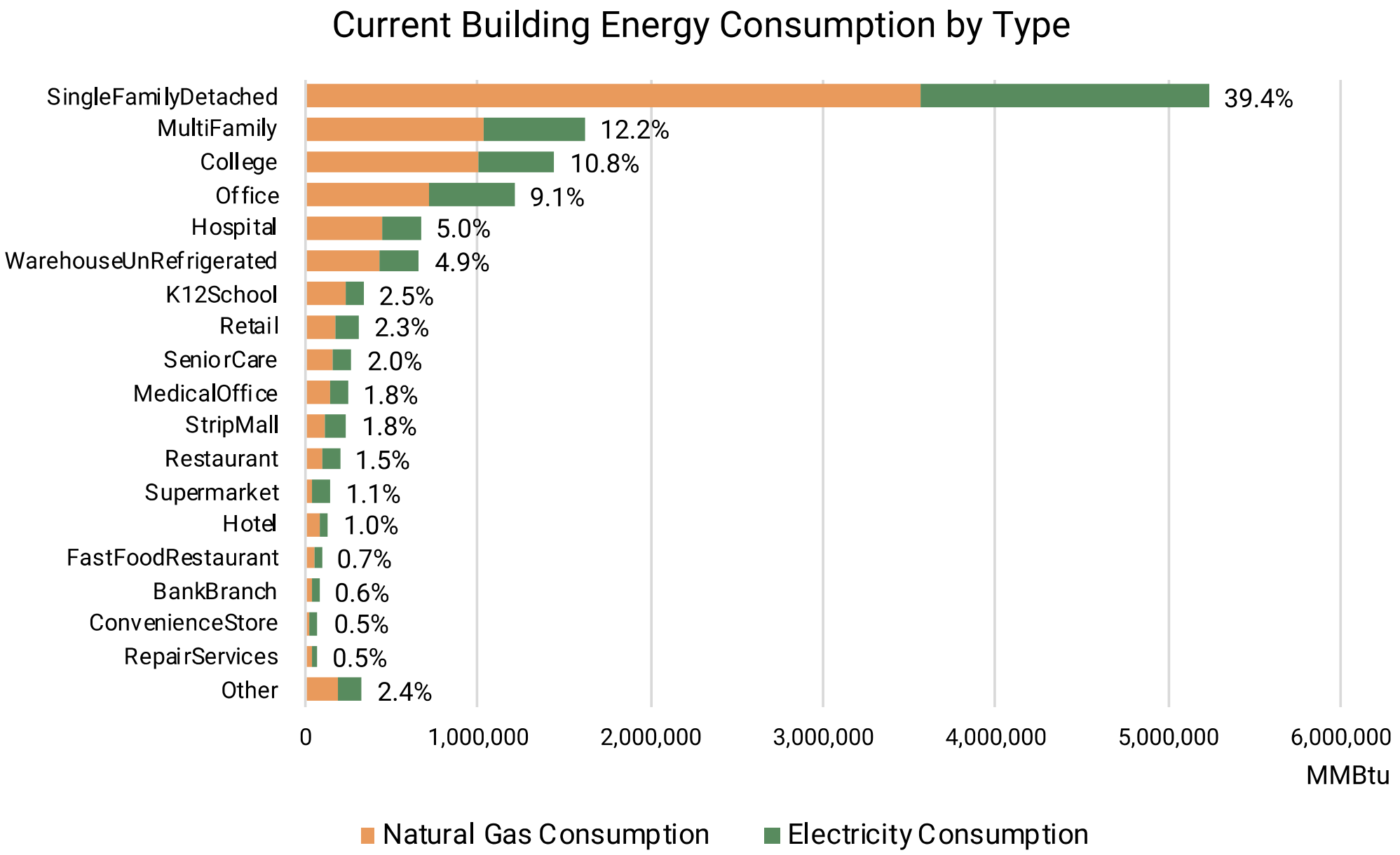


Current Building Energy Consumption by Fuel & Type



BUILDING ENERGY USE SUMMARY

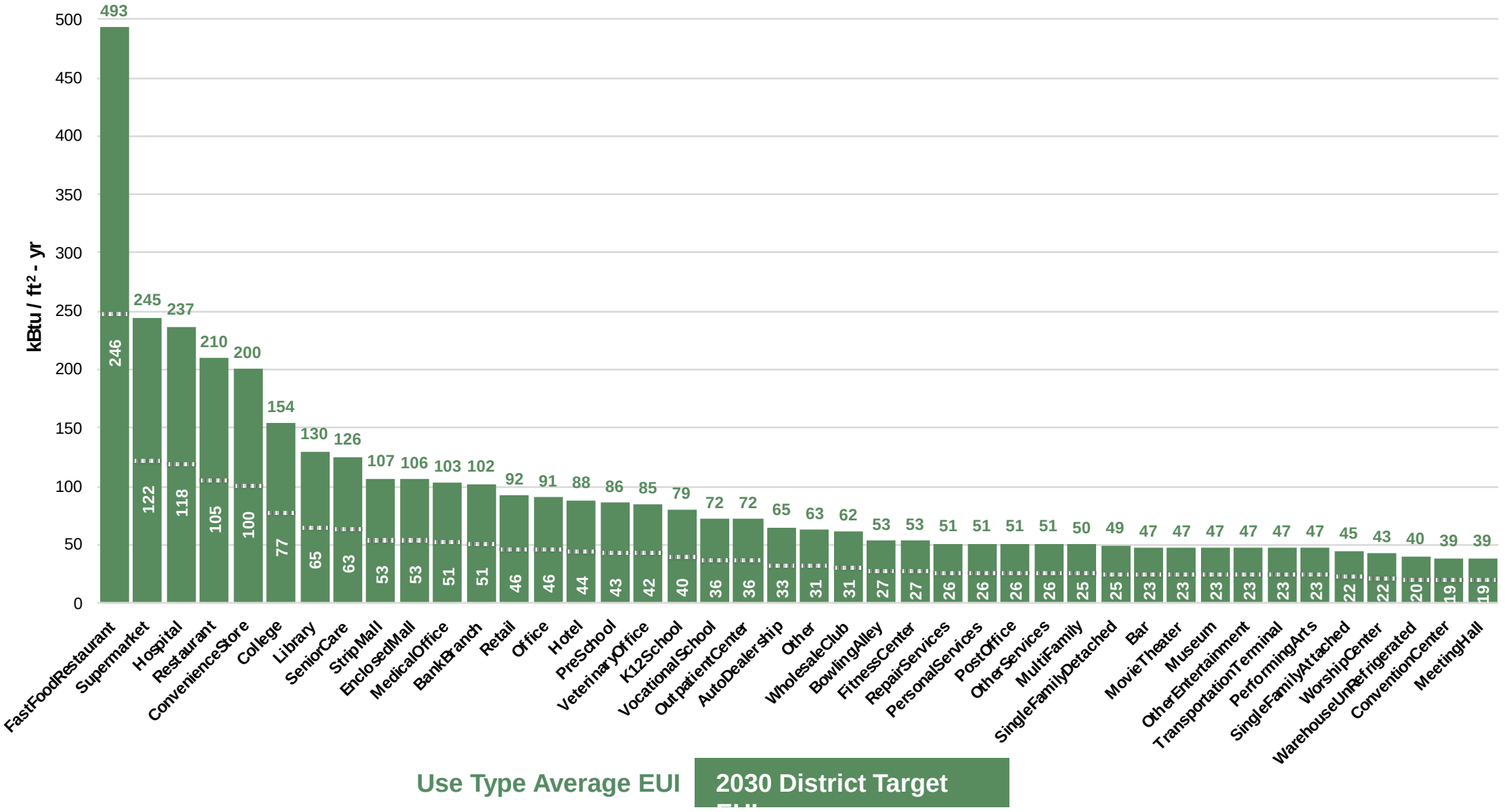
GRAND RAPIDS, MI



BUILDING ENERGY USE SUMMARY

GRAND RAPIDS, MI

Use Type Average EUIs and 2030 District Target EUIs



Use Type Average EUI | 2030 District Target EUI

BUILDING ENERGY USE SUMMARY

GRAND RAPIDS, MI

Use Type	Average EUI	2030 District EUI	Use Type	Average EUI	2030 District EUI
AutoDealership	65	33	OtherEntertainment	47	23
BankBranch	102	51	OtherServices	51	26
Bar	47	23	OutpatientCenter	72	36
BowlingAlley	53	27	PerformingArts	47	23
College	154	77	PersonalServices	51	26
ConvenienceStore	200	100	PostOffice	51	26
ConventionCenter	39	19	PreSchool	86	43
EnclosedMall	106	53	RepairServices	51	26
FastFoodRestaurant	493	246	Restaurant	210	105
FitnessCenter	53	27	Retail	92	46
Hospital	237	118	SeniorCare	126	63
Hotel	88	44	SingleFamilyAttached	45	22
K12School	79	40	SingleFamilyDetached	49	25
Library	130	65	StripMall	107	53
MedicalOffice	103	51	Supermarket	245	122
MeetingHall	39	19	TransportationTerminal	47	23
MovieTheater	47	23	VeterinaryOffice	85	42
MultiFamily	50	25	VocationalSchool	72	36
Museum	47	23	WarehouseUnRefrigerated	40	20
Office	91	46	WholesaleClub	62	31
Other	63	31	WorshipCenter	43	22

METHODOLOGY

1. Used Zero Tool to determine baseline EUIs for each property
2. Used EPA regional fuel split data to determine electricity/natural gas fuel split for each space type
3. Calculated electricity, natural gas, and total energy consumption for each property

QUESTIONS

ASSUMPTIONS

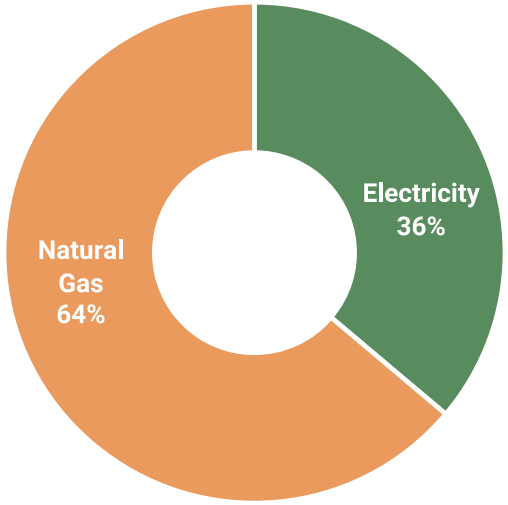
DATA SOURCES

1. Zero Tool/CBECS 2003
2. EPA regional fuel split by space type

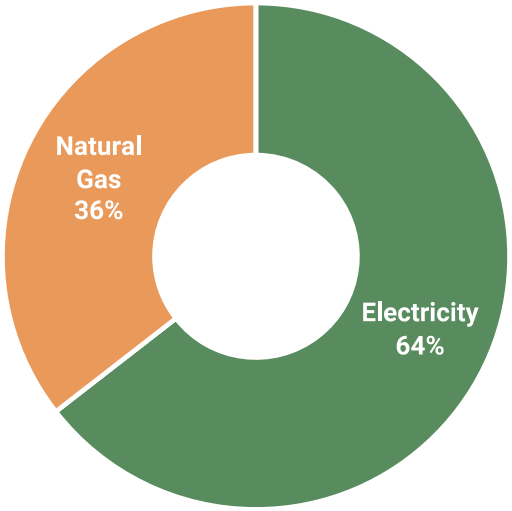
BUILDING ENERGY SOURCE SUMMARY

GRAND RAPIDS, MI

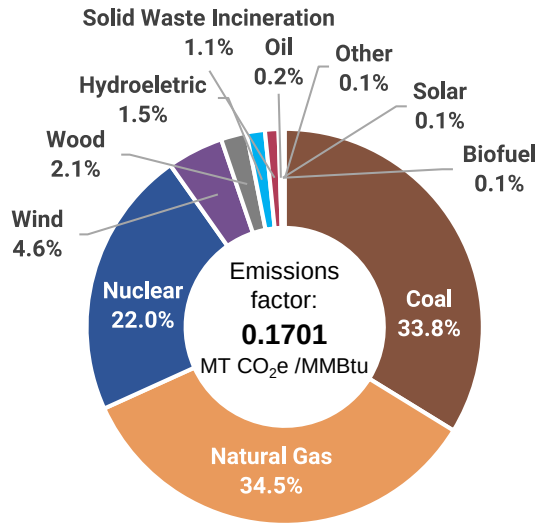
Current Fuel Mix: Energy Consumption



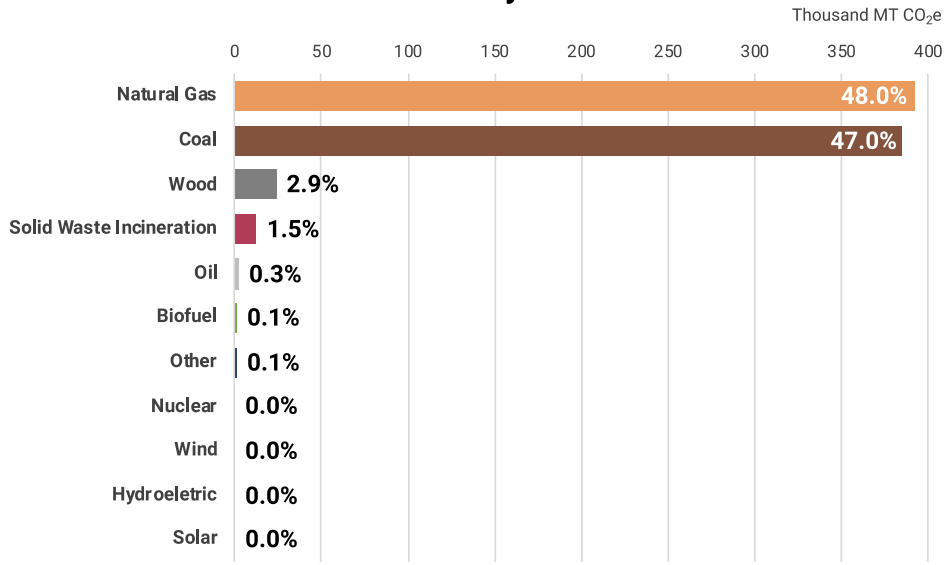
Current GHG Emissions



Current Electricity Grid Fuel Mix



Total Electricity Emissions



*Emission factor provided by utility (not calculated through aggregation using EPA emissions factors)

BUILDING ENERGY SOURCE SUMMARY: PROCESS

GRAND RAPIDS, MI

METHODOLOGY

1. EPA regional fuel split used to calculate electricity/natural gas fuel split for Grand Rapids' building stock
2. Consumers Energy electricity grid mix used to determine electricity emissions by fuel type

QUESTIONS

DATA SOURCES

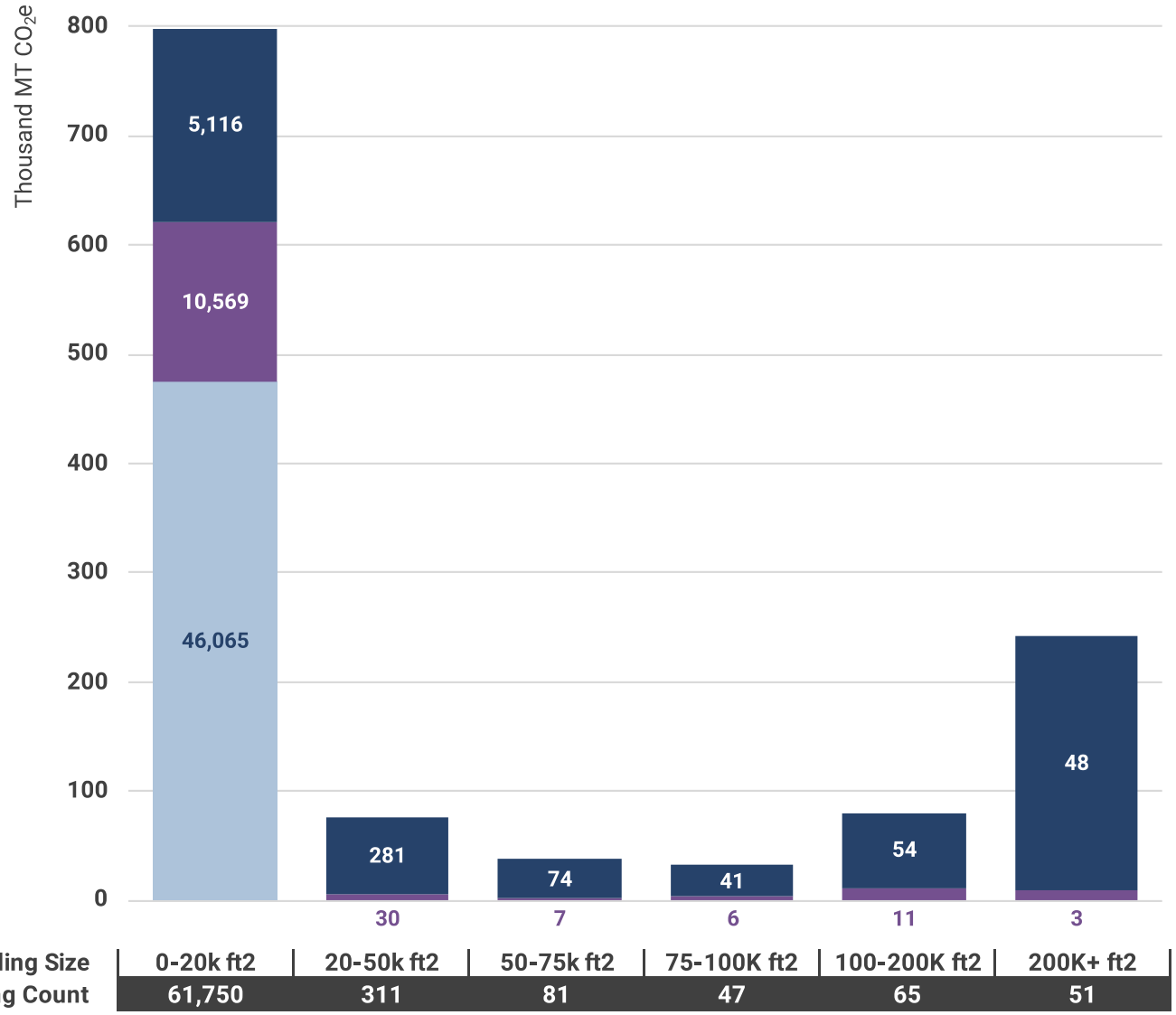
1. EPA regional fuel split by space type
2. Consumers Energy Electricity grid mix

ASSUMPTIONS

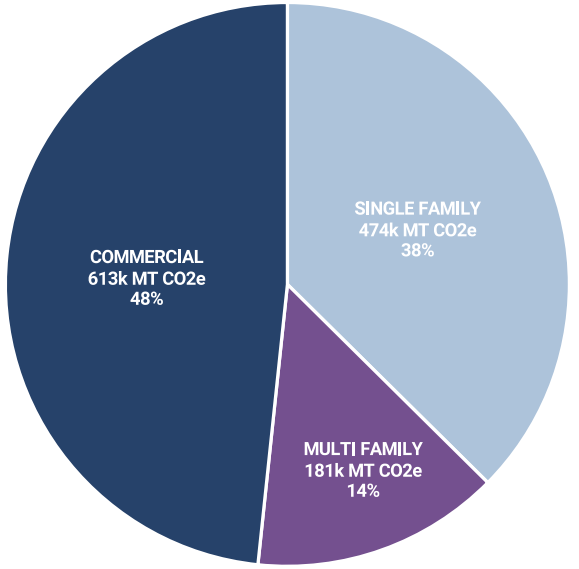
BUILDING EMISSIONS SUMMARY

GRAND RAPIDS, MI

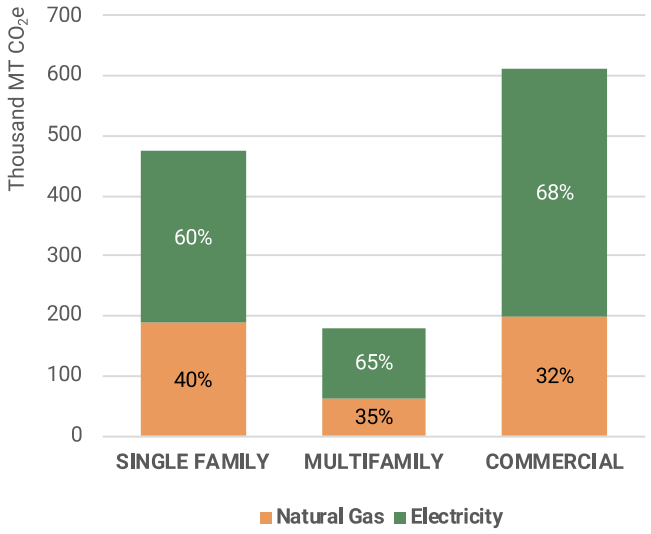
Current Building GHG Emissions by Size



Current Building GHG Emissions by Type



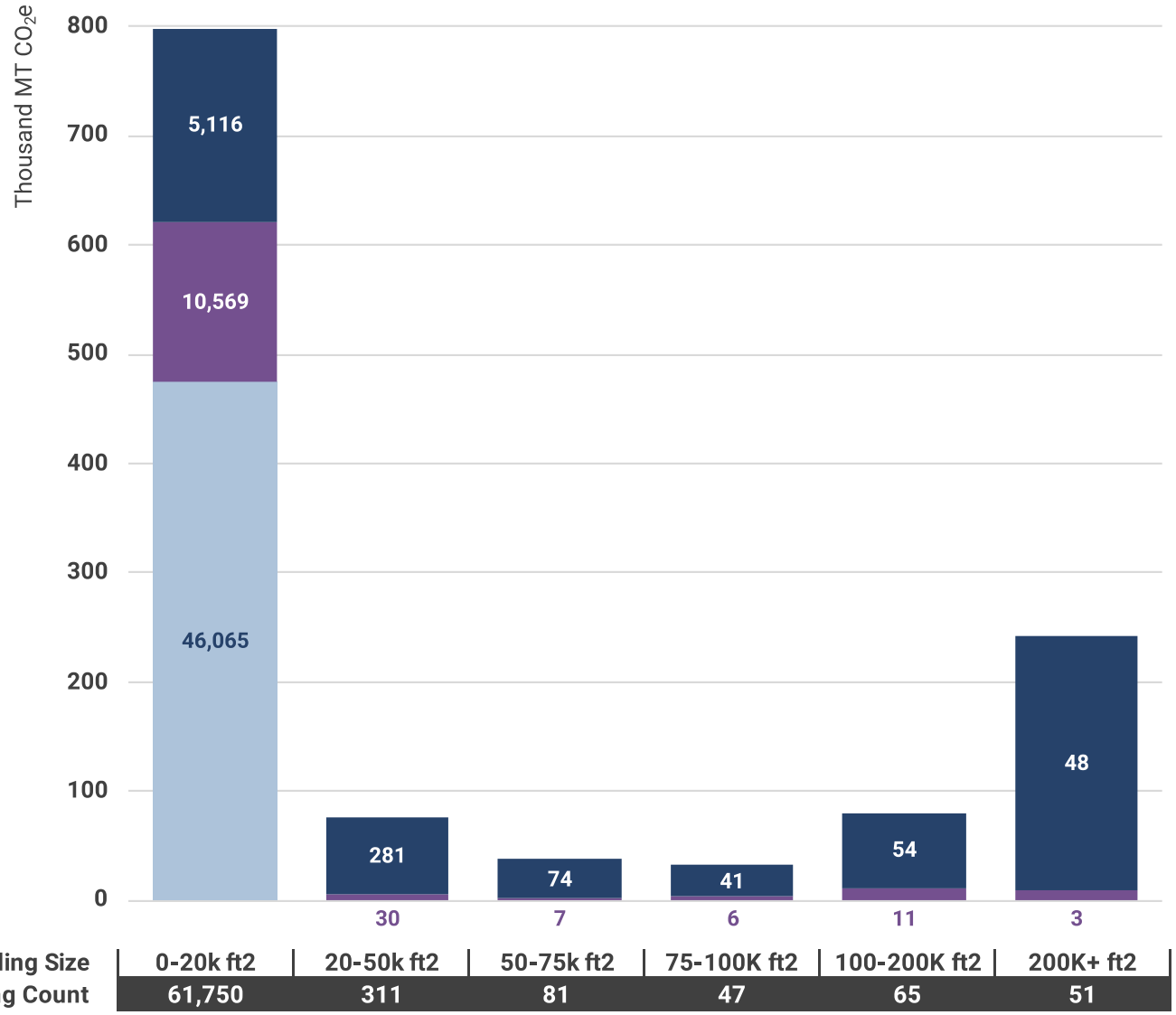
Current Building GHG Emissions by Fuel & Type



BUILDING EMISSIONS SUMMARY

GRAND RAPIDS, MI

Current Building GHG Emissions by Size



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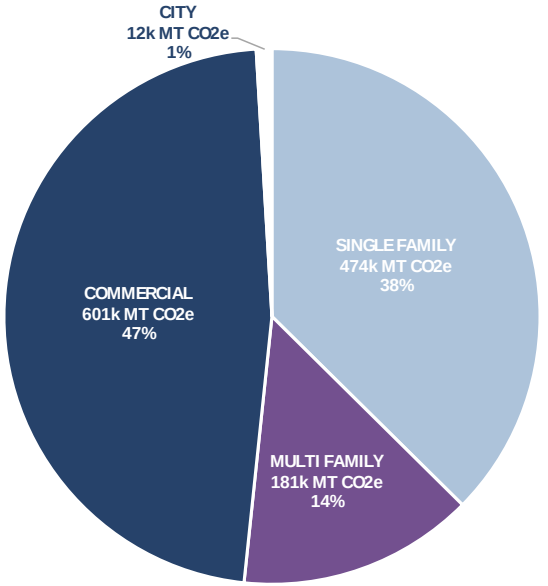

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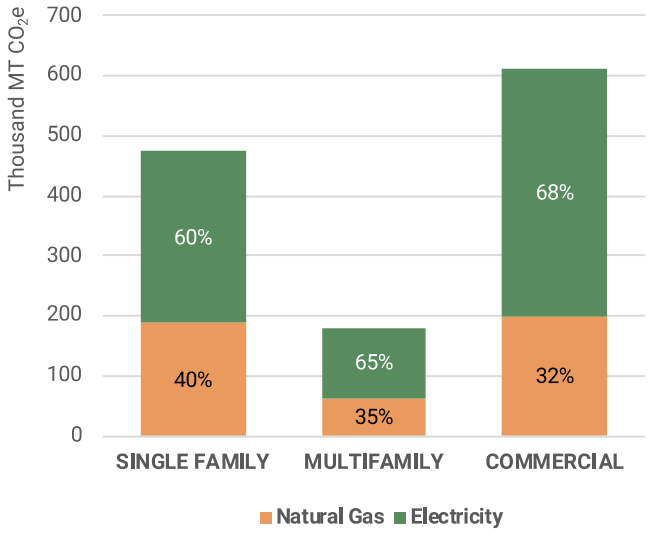

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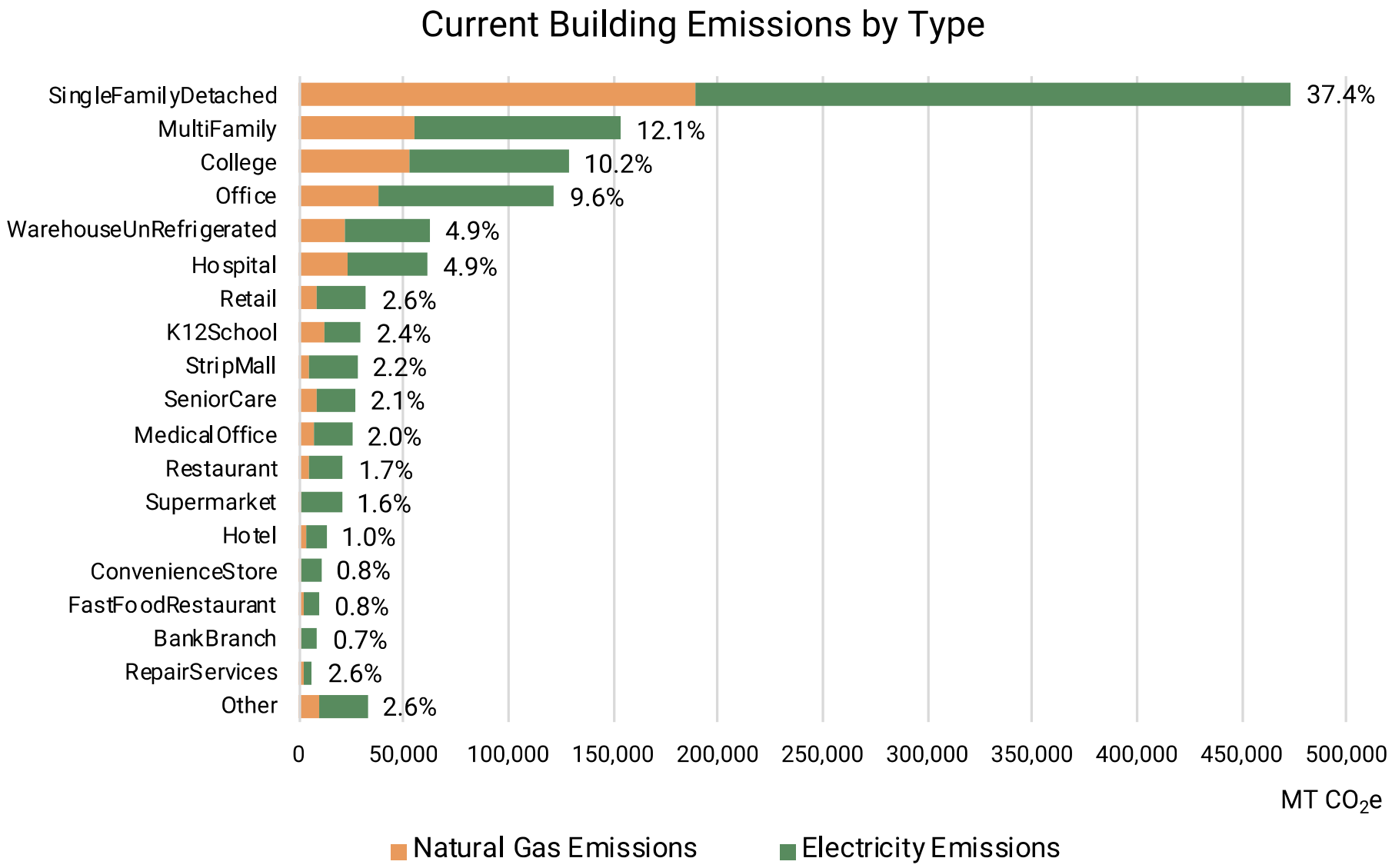


BUILDING EMISSIONS SUMMARY: PROCESS

METHODOLOGY

1. Used eGRID RFCM region electricity emissions factor and EPA's national natural gas emissions factor to calculate building stock emissions

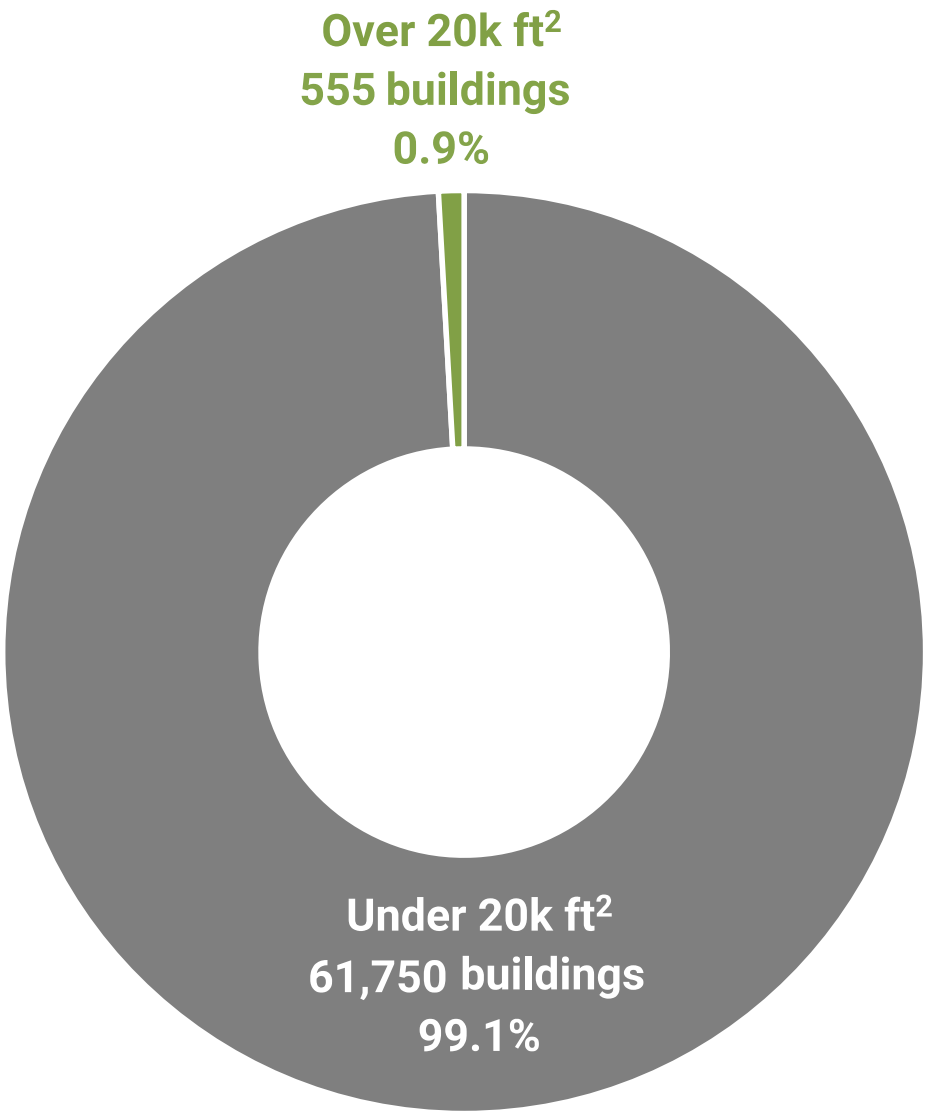
QUESTIONS

ASSUMPTIONS

DATA SOURCES

1. eGRID RFCM region electricity grid emissions factor
2. EPA's national average natural gas emissions factor

Current Number of Buildings by Size



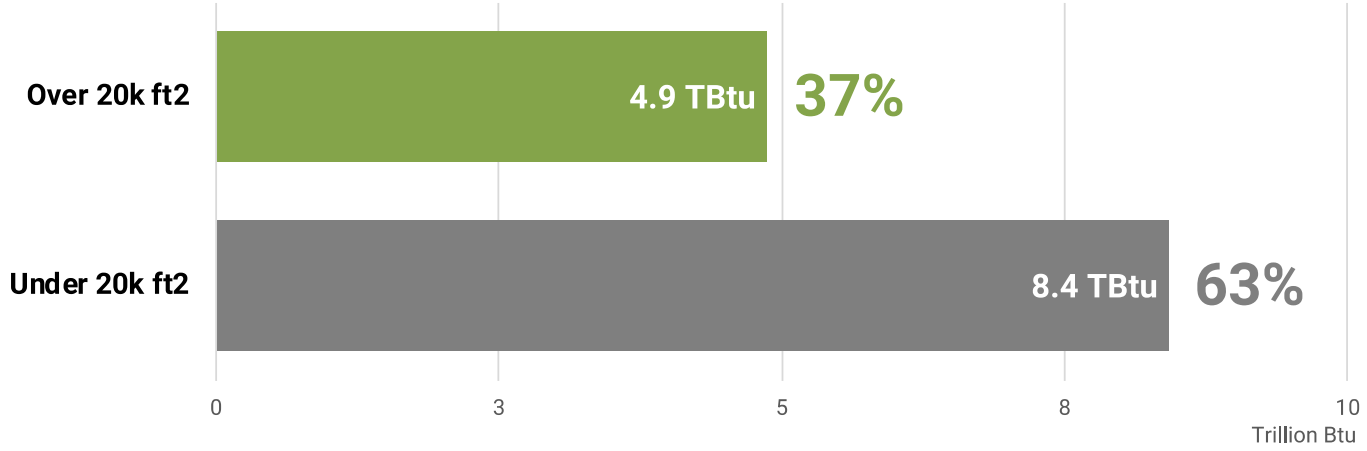
0.9%

of the total number of buildings in Grand Rapids, MI are greater than 20,000 ft² and consume

37%

of citywide building sector energy.

Total Building Energy Consumption by Size



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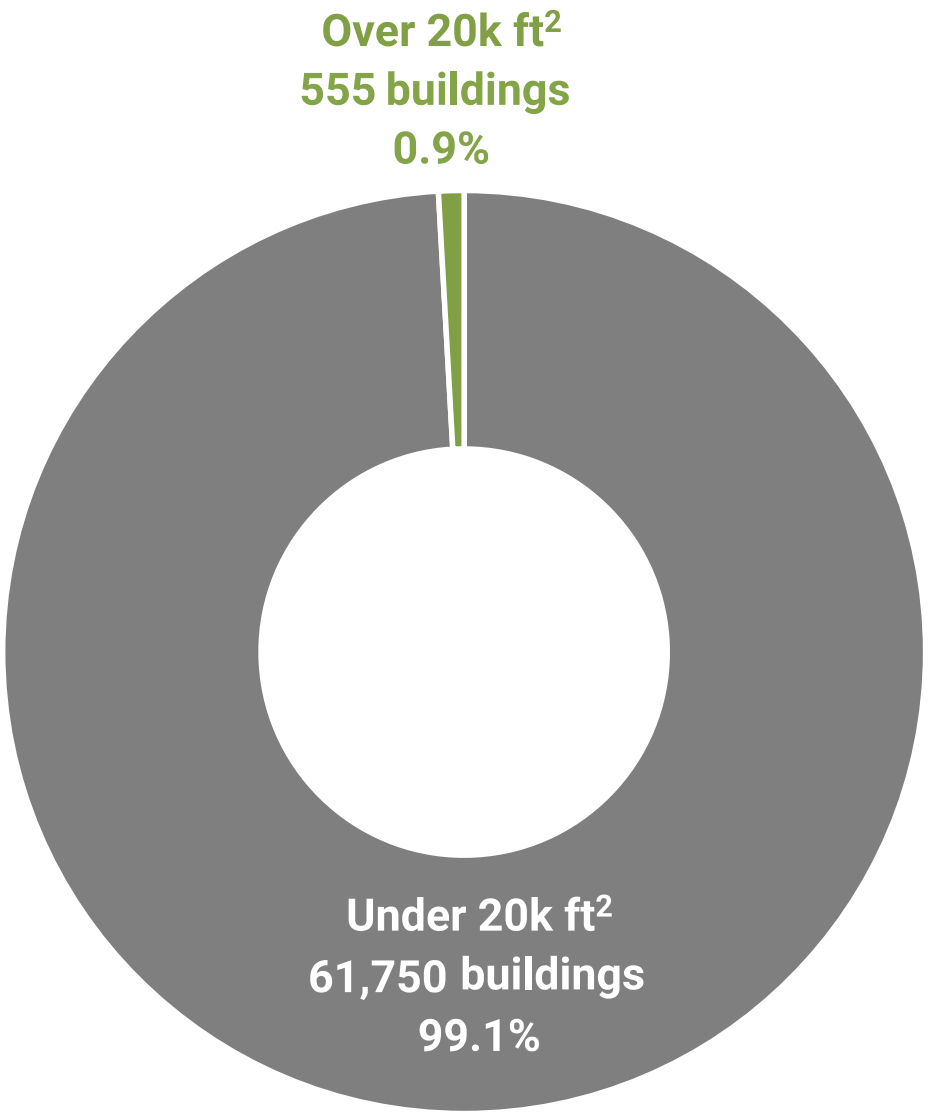

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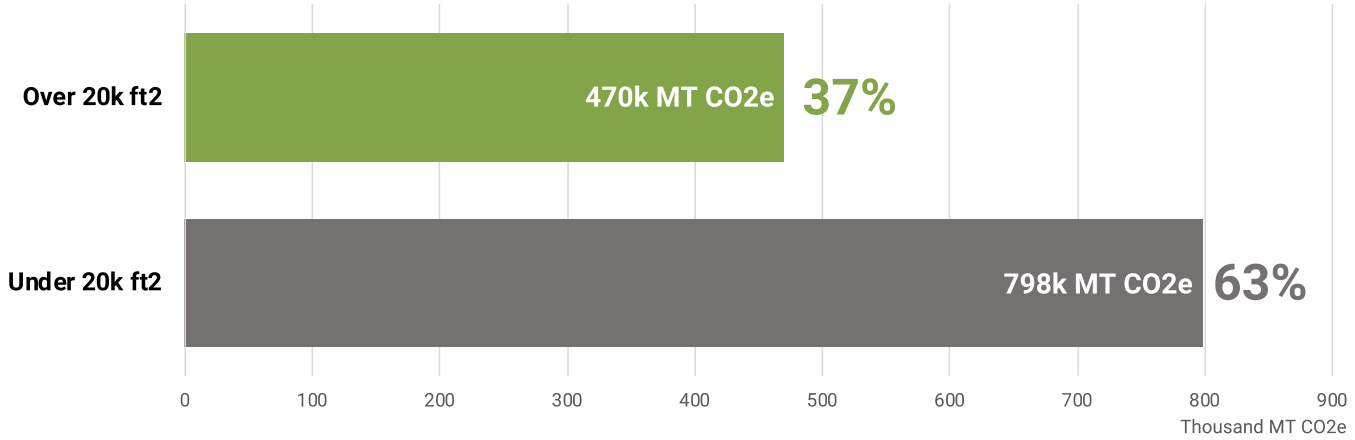

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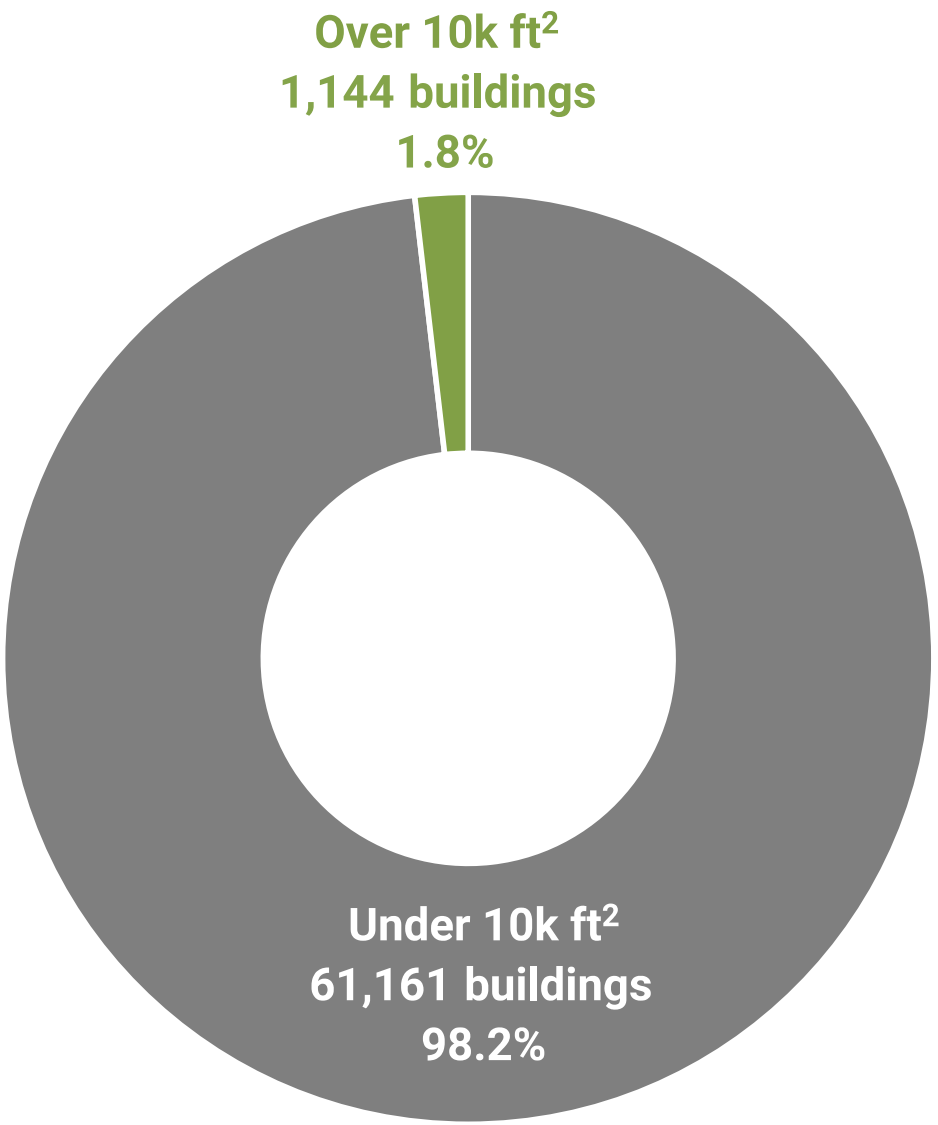


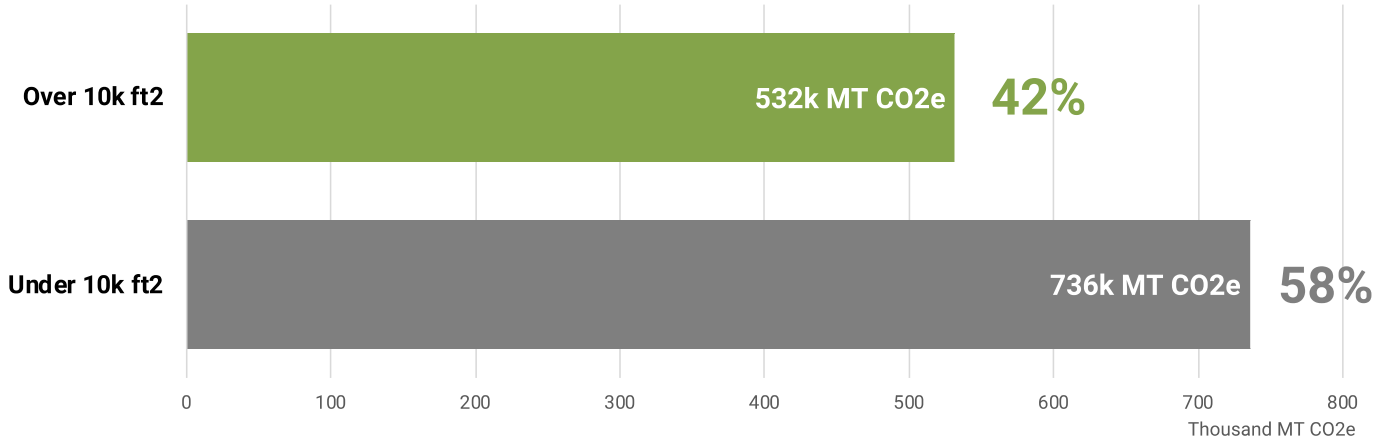
1.8%

of the total number of buildings in Grand Rapids, MI are greater than 10,000 ft² and consume

42%

of citywide building sector energy.

Total Building GHG Emissions by Size



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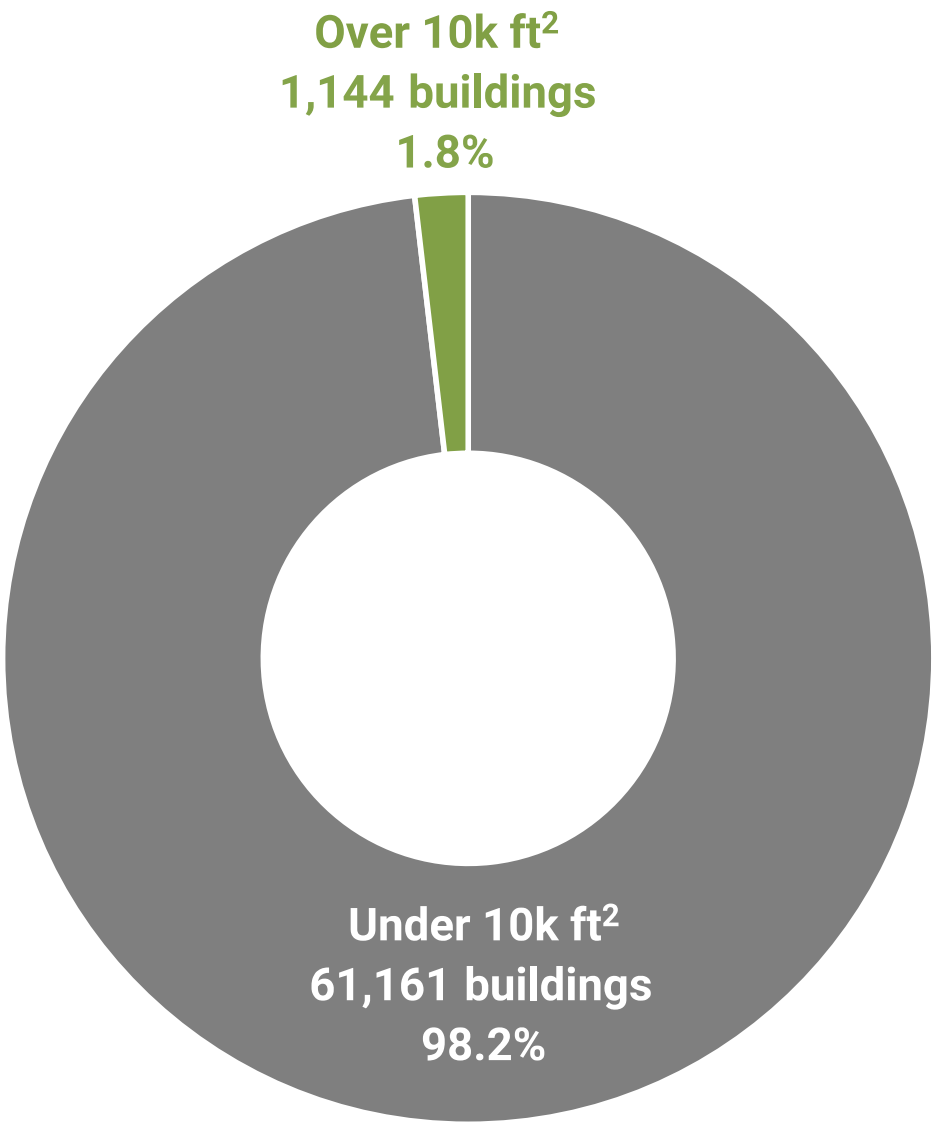

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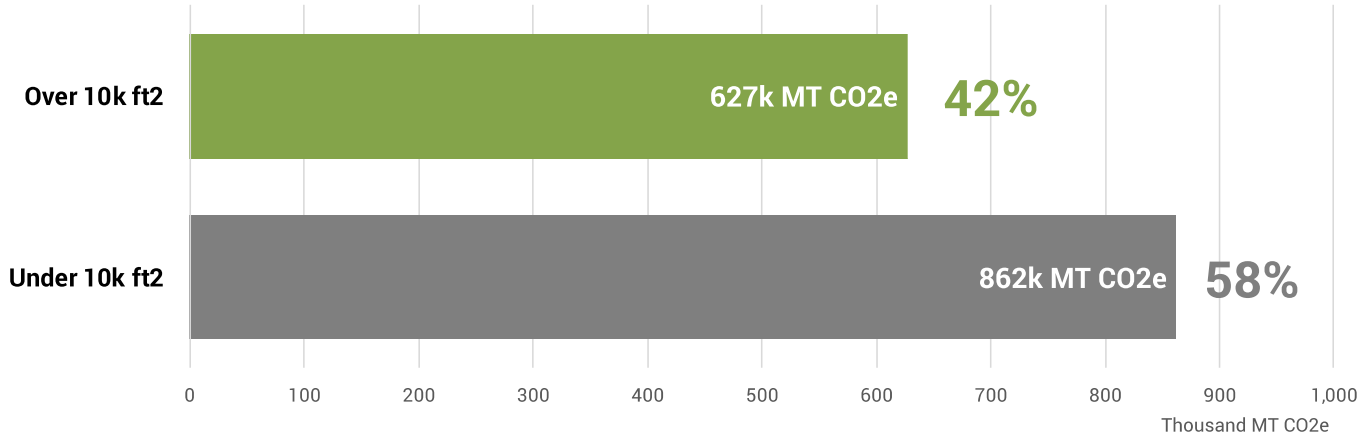
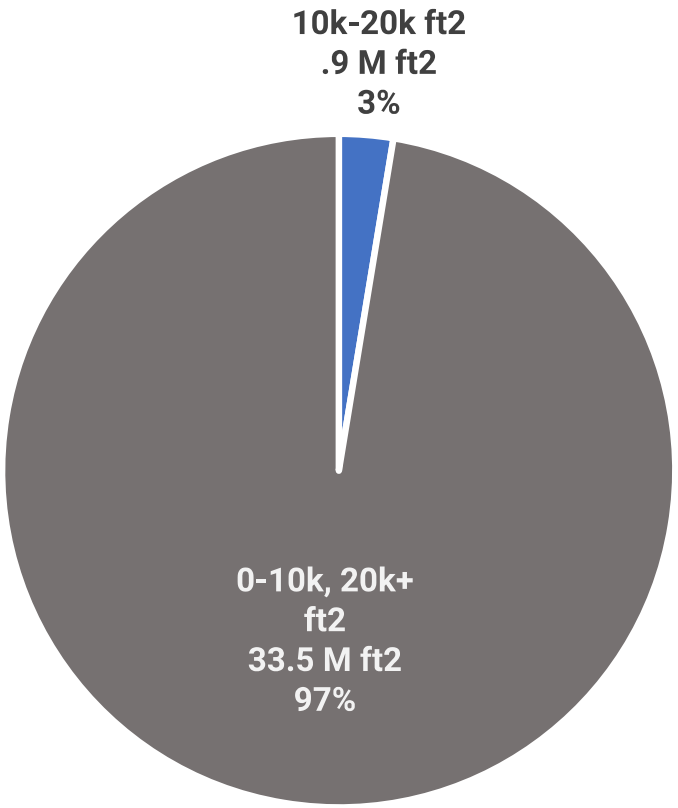
Total Building GHG Emissions by Size



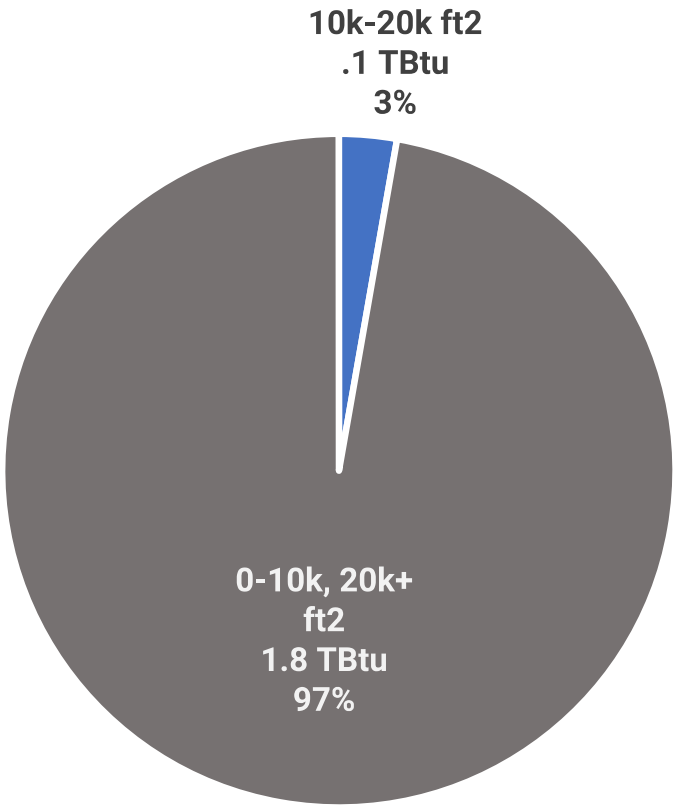
10k-20k ft² MULTIFAMILY BUILDINGS

GRAND RAPIDS, MI

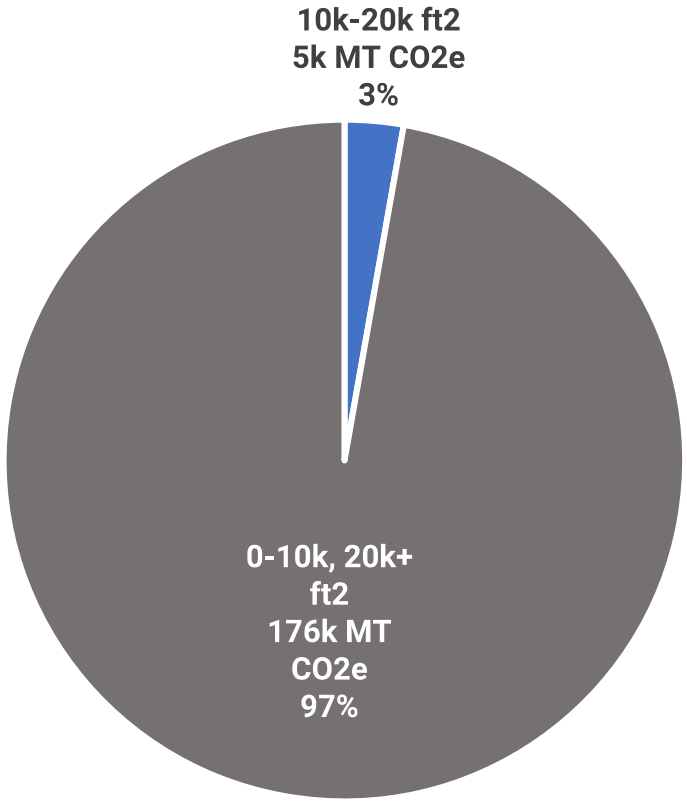
Multifamily Floor Area



Multifamily Energy Consumption



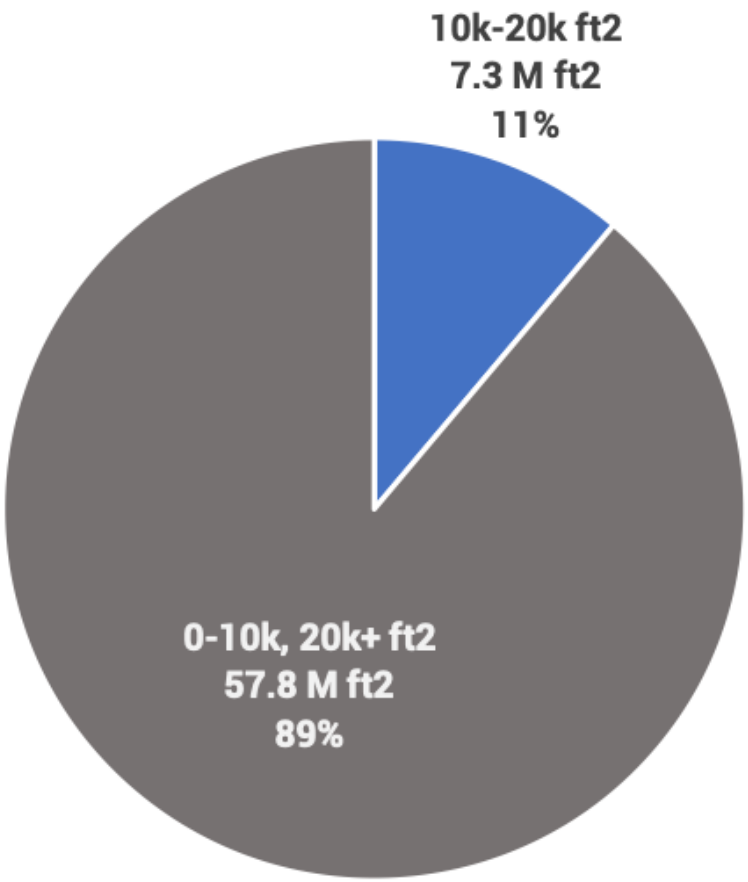
Multifamily GHG Emissions



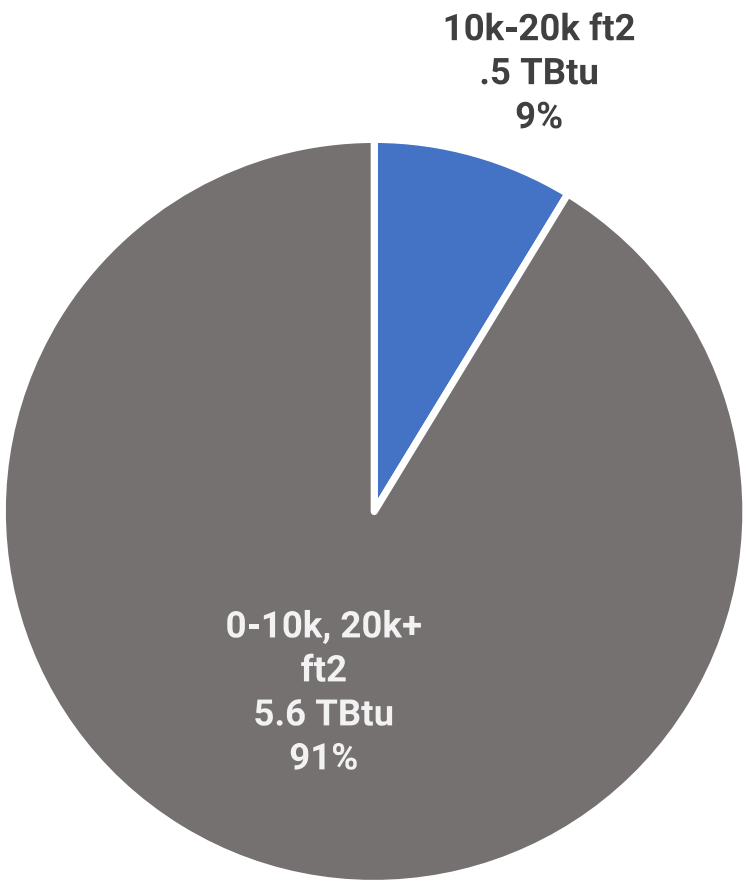
10k-20k ft² COMMERCIAL BUILDINGS

GRAND RAPIDS, MI

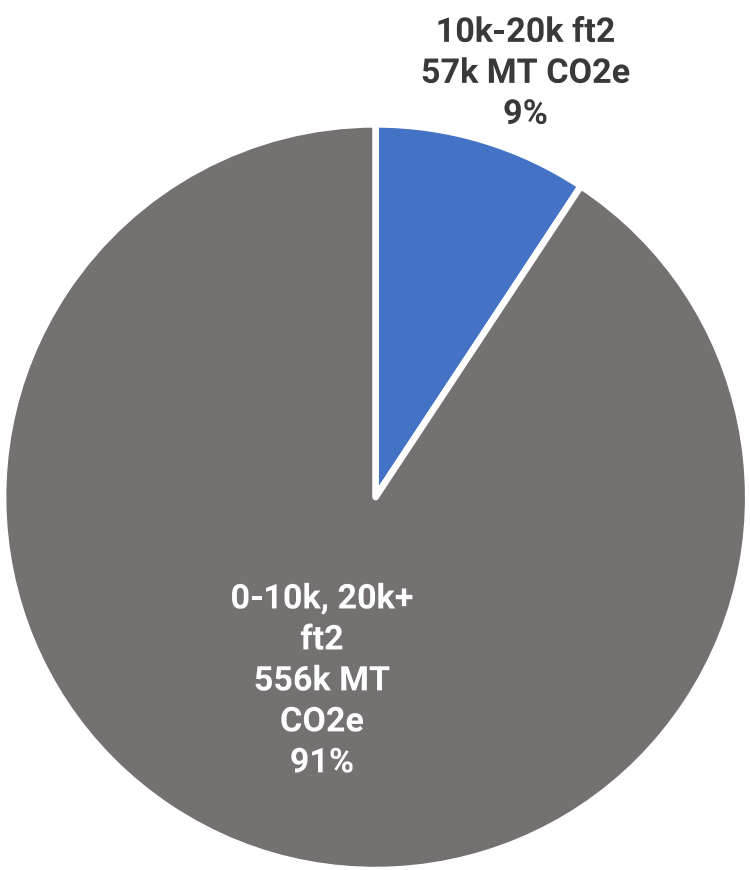
Commercial Floor Area



Commercial Energy Consumption

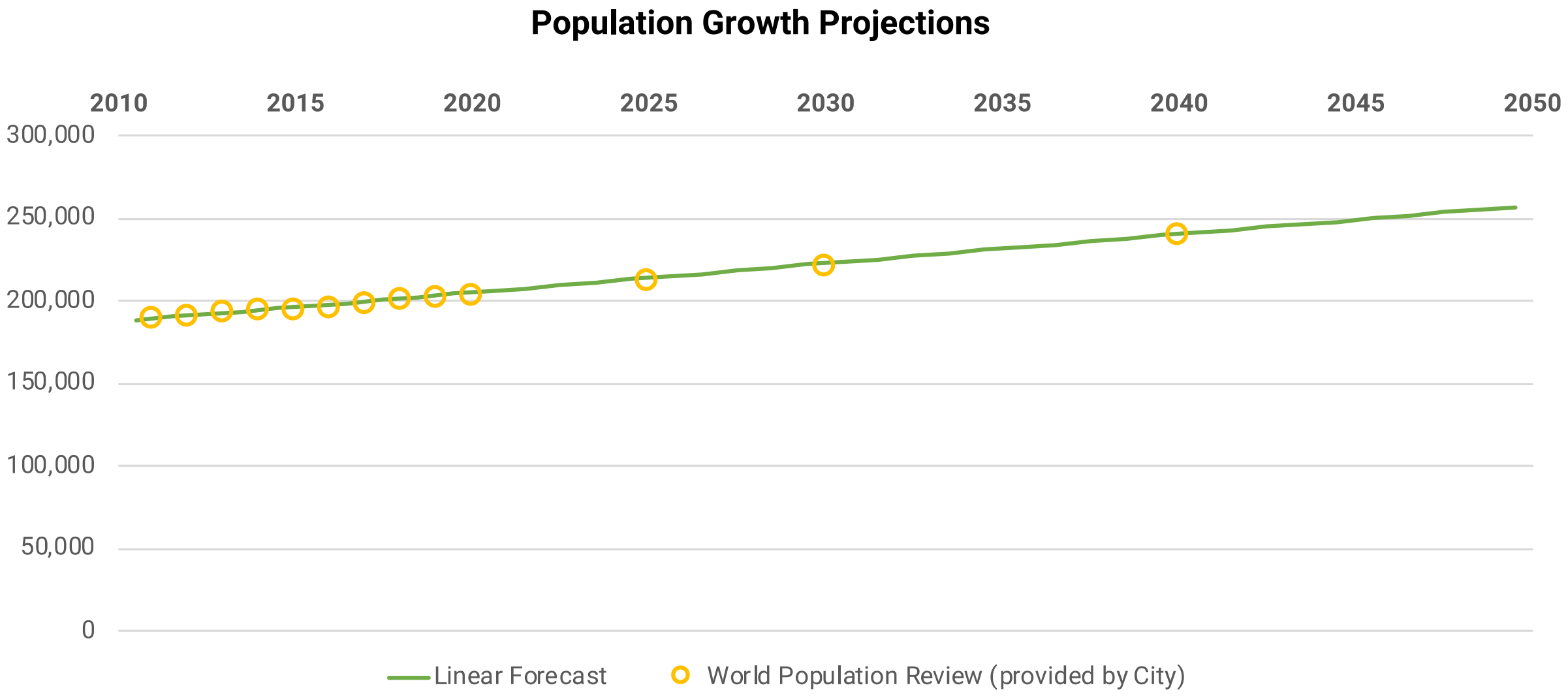


Commercial GHG Emissions



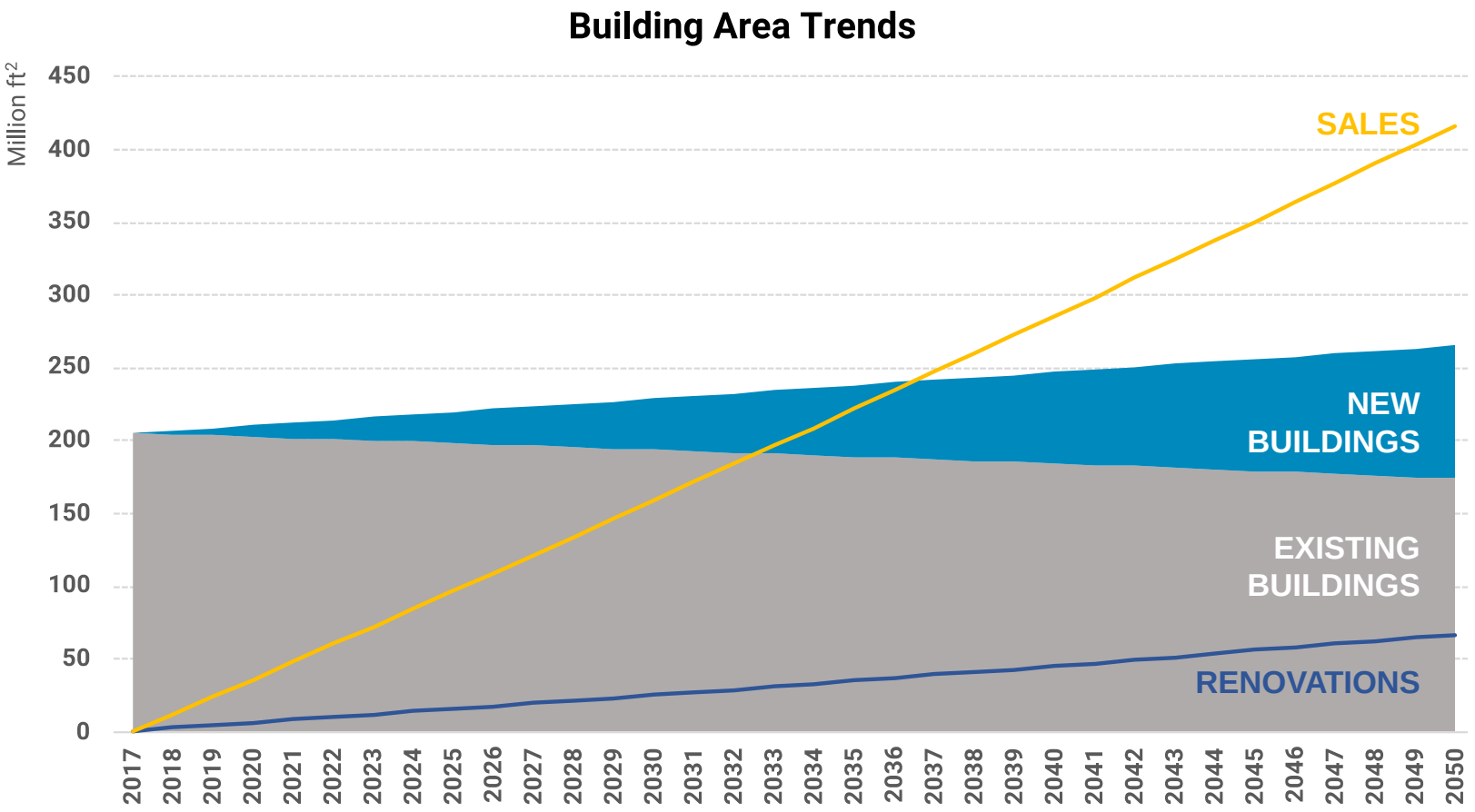
BUILDING STOCK PROJECTIONS ANALYSIS

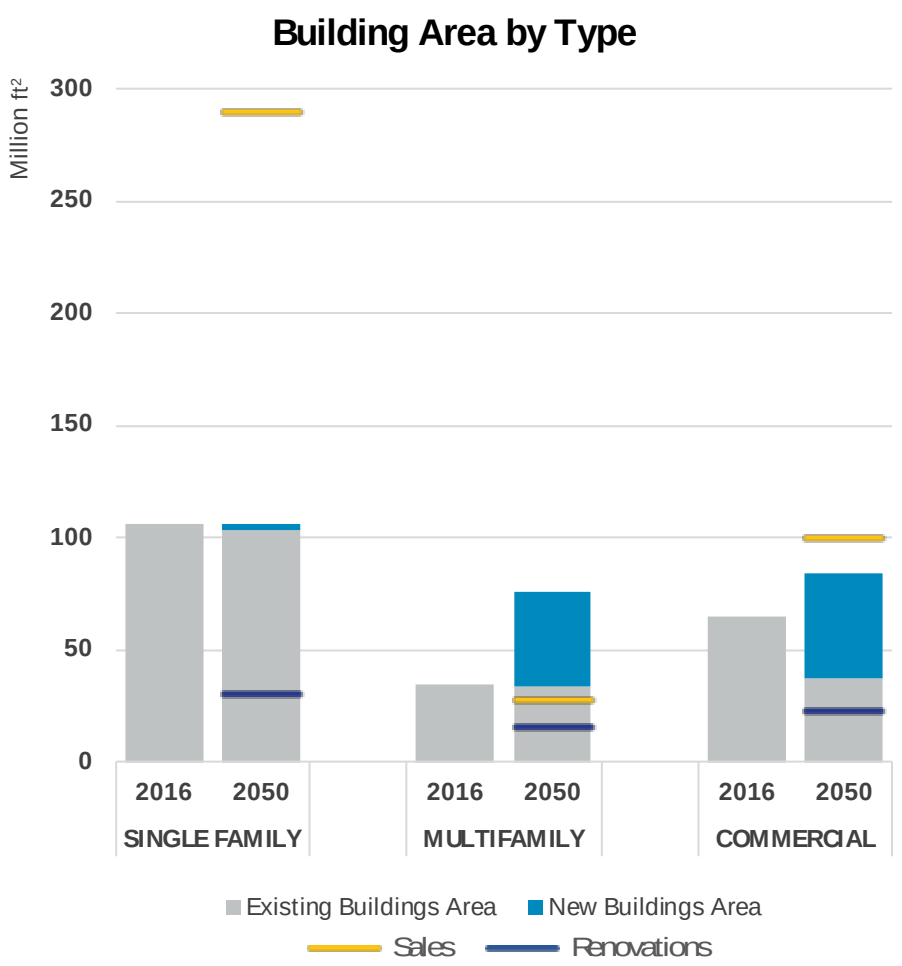
POPULATION PROJECTIONS



BUILDING AREA PROJECTIONS

GRAND RAPIDS, MI





METHODOLOGY

1. Used World Population Review projections for Grand Rapids to forecast population growth to 2050.
2. Estimated total floor area growth to 2050 for each building use category, based on population projections and 2017 average square feet per inhabitant, assuming all new residential growth is multifamily.
3. Used 7 years of City of Grand Rapids demolition permits (2011-2017) provided by the Development Center to calculate average annual demolition rates for each building use category; applied rates to total floor area projections to estimate existing building stock reduction and new building stock growth to 2050, assuming all new residential growth is multifamily.
4. Used 16 years (2002-2017) of Grand Rapids building permit data to calculate average annual renovation rates and 28 years (1990-2017) of sales records to calculate sales rates for each building use category; applied rates to total floor area projections to estimate cumulative floor area renovated by 2050. Used 7 years (2011-2017) of residential demo+reno permit data with unit counts to estimate average units/MFR building. Applied this to sales unit count to estimate MFR buildings sold.

ASSUMPTIONS

- All residential floor area growth to 2050 will be multifamily – the only new single family floor area will be replacement of demolished single family floor area.

QUESTIONS

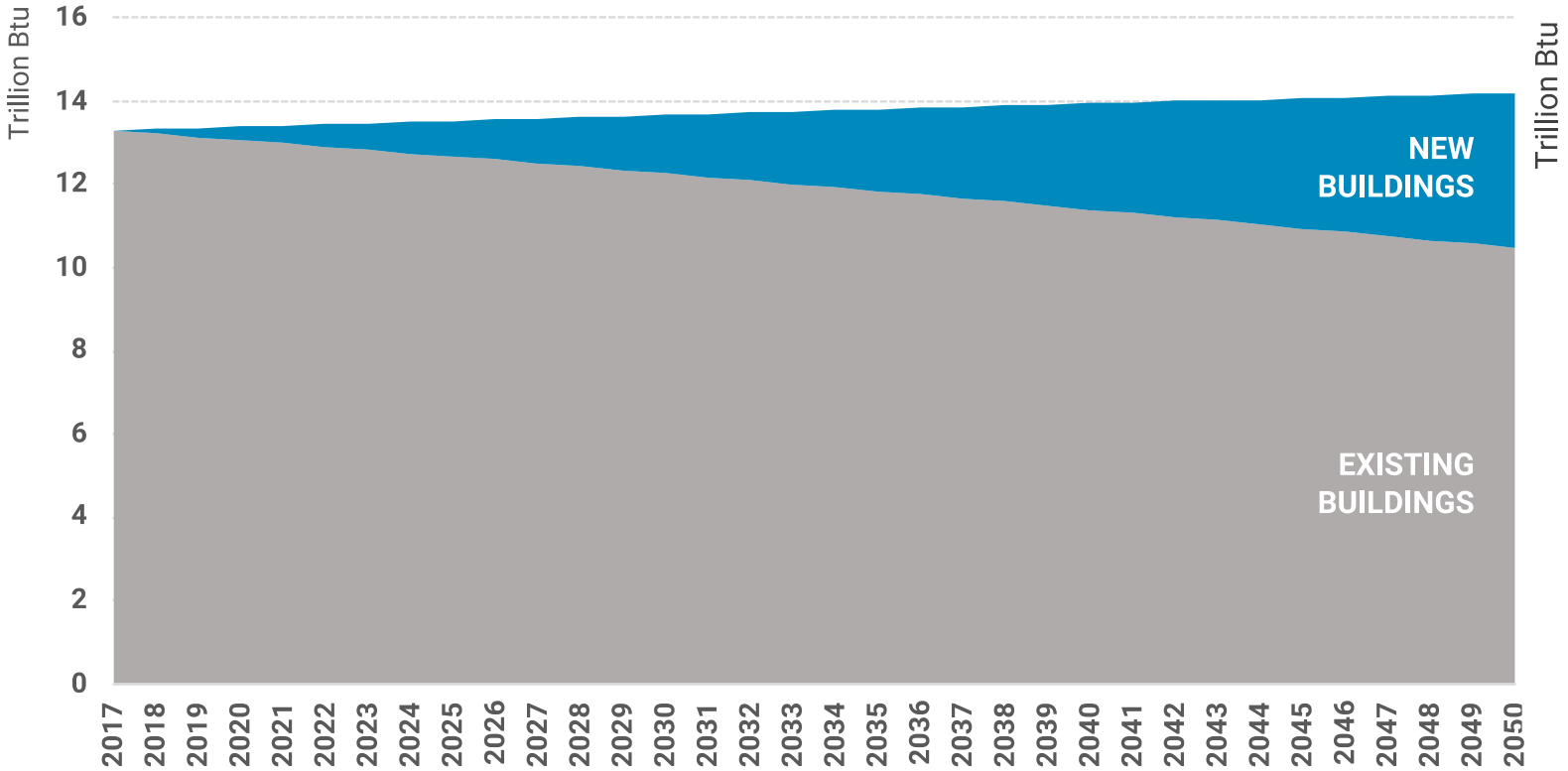
DATA SOURCES

1. World Population Review for City of Grand Rapids, provided by Alison Sutter
2. City of Grand Rapids Demolition, Renovation, and Sales Permits, provided by Louis Canfield
3. City of Grand Rapids Residential Demolition and Renovation Permits, provided by Louis Canfield

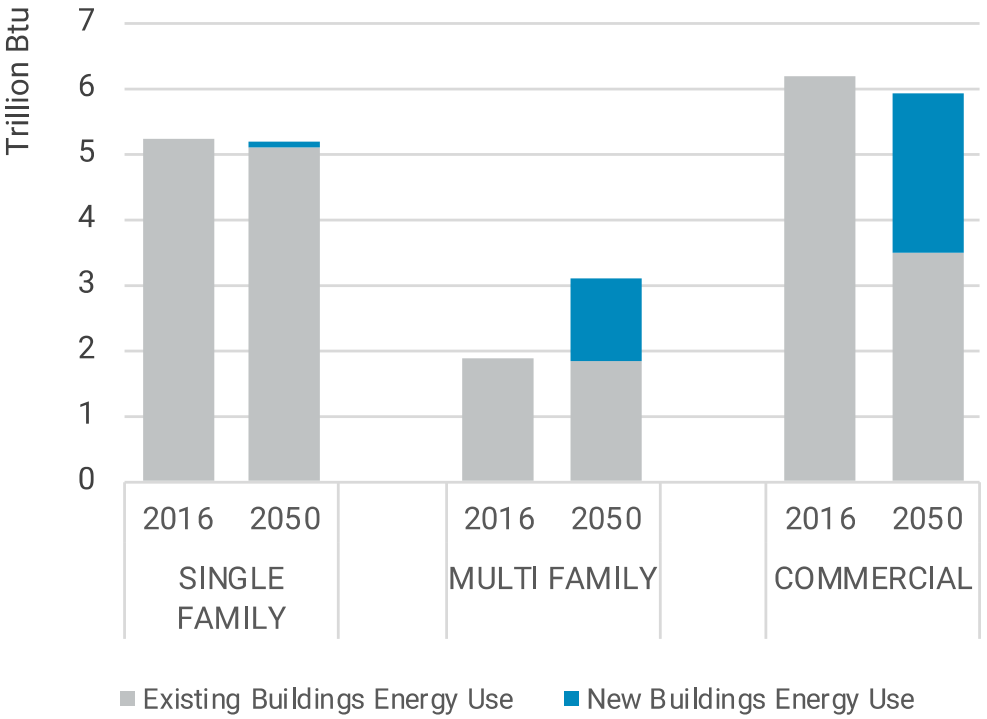
BUILDING ENERGY PROJECTIONS

GRAND RAPIDS, MI

Building Energy Use Trends



Building Energy Use by Type



METHODOLOGY

1. Used floor area growth projections, current average EUI for each building use category, and current average electricity/natural gas fuel split for each building use category to estimate electricity and natural gas consumption existing buildings to 2050.
2. Used floor area growth projections, new construction EUI assumptions based on reductions from current code, and current average electricity/natural gas fuel split for each building use category to estimate electricity and natural gas consumption existing buildings to 2050.

ASSUMPTIONS

- New buildings are meeting current code (46% better than existing building EUIs for COM & MFR, 45% better for SFR)
- No change in fuel split over time for existing or new buildings

QUESTIONS

1. Are there planned existing building stock efficiency improvement programs that we should take into account?
2. Are there planned new building code improvements beyond current code that we should take into account?
3. Are there planned programs that would affect fuel split (e.g. electrification of heating) that we should take into account?

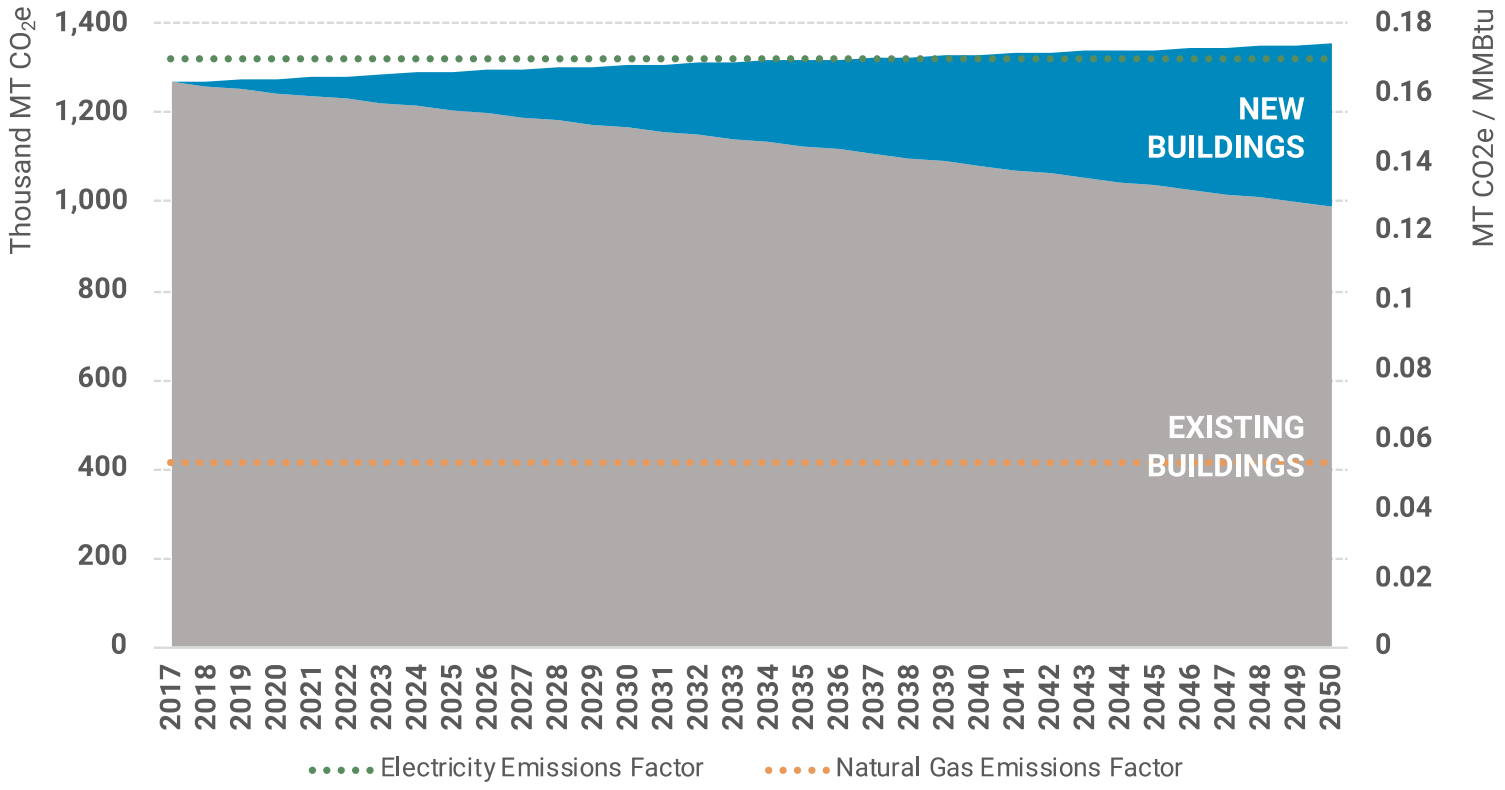
DATA SOURCES

1. State of Michigan Energy Codes: efficiency equivalent to ASHRAE 90.1 2013 for MFR & COM, “less than” IECC 2015 for SFR

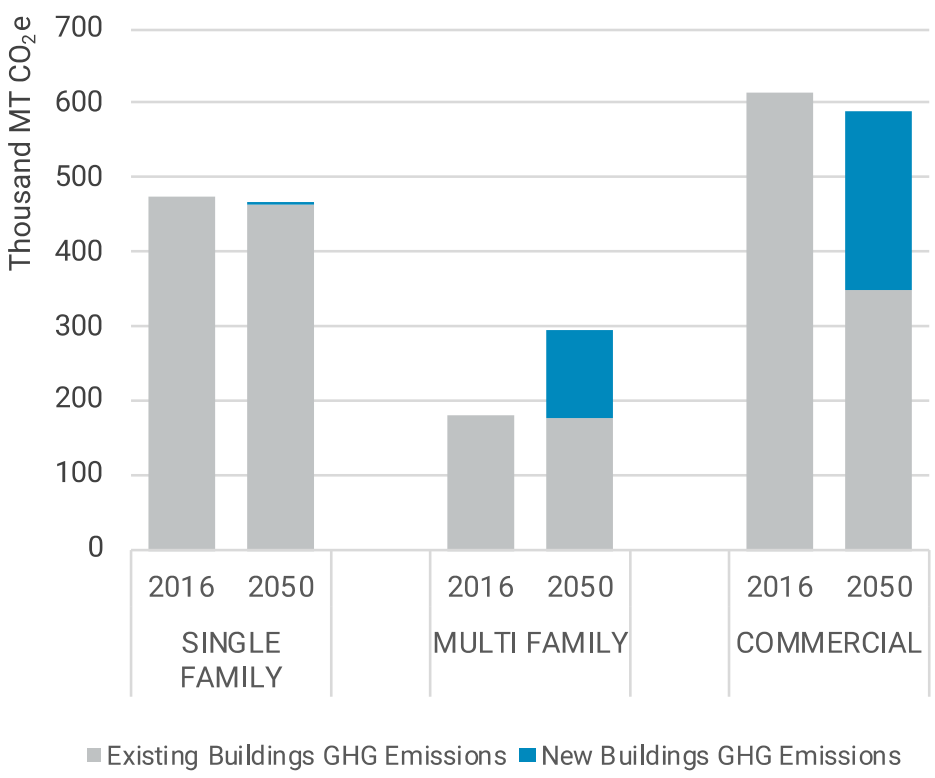
BUILDING EMISSIONS PROJECTIONS

GRAND RAPIDS, MI

Building GHG Emissions Trends



Building GHG Emissions by Type



METHODOLOGY

1. Used energy consumption projections and current electricity and natural gas emissions factors to estimate electricity and natural gas emissions for new and existing buildings to 2050.

QUESTIONS

1. How do planned electricity grid renewable energy levels change electricity emissions factor?

ASSUMPTIONS

- No change in electricity or natural gas emissions factors over time

DATA SOURCES

1. eGRID RFCM region electricity grid emissions factor
2. EPA's national average natural gas emissions factor

BUILDING STOCK INSIGHTS

BUILDING STOCK INSIGHTS*

GRAND RAPIDS, MI

KEY TAKEAWAYS	POLICY IMPLICATIONS
Single-family residential buildings account for 40% of total building energy use and 39% of emissions.	Energy efficiency upgrades for SFR buildings have potential to significantly decrease emissions.
Electricity supplies 36% of building energy but accounts for 64% of emissions. Electrification policies lead to higher emissions due to dirtiness and volatility of the grid.	Decarbonizing the electric grid, including renewable energy generation and procurement requirements, represents a significant opportunity to achieve emissions reductions.
The 1,114 buildings over 10,000 ft^2 (1.8% of all buildings) account for 41% of current total building energy use and 42% of building sector GHG emissions.	Energy upgrade policies aimed at buildings > 10k ft^2 have the potential for significant emissions reductions in the existing building stock.
Renovation rates are currently projected to affect approximately half of existing buildings by 2050 (and nearly all of existing commercial buildings).	Point of renovation policies for energy upgrades have the potential to affect buildings and significantly decrease emissions.
Sales rates are currently projected to affect more than 100% of single family and commercial buildings by 2050.	Point of sale policies for energy upgrades have the potential to affect buildings and significantly decrease emissions.
Significant commercial building demolition as well as new multifamily growth provides an opportunity for replacement with low or zero emissions new construction.	ZERO Code provides an opportunity to avoid significant emissions in new commercial construction.

Energy upgrades and decarbonization policies include: 1) improvements to the energy efficiency of a building and its systems, including a shift to electric systems that can be powered by renewable energy sources, and/or 2) the generation or procurement of renewable energy.

* Heavily dependent on accuracy of assumptions about fuel split, emissions factors, and new construction and sales rates. Subject to change if assumptions are updated.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