Belmont CO_2 emissions, 2014-2021

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Updated CO_2 emissions analysis for period from 2014-2021

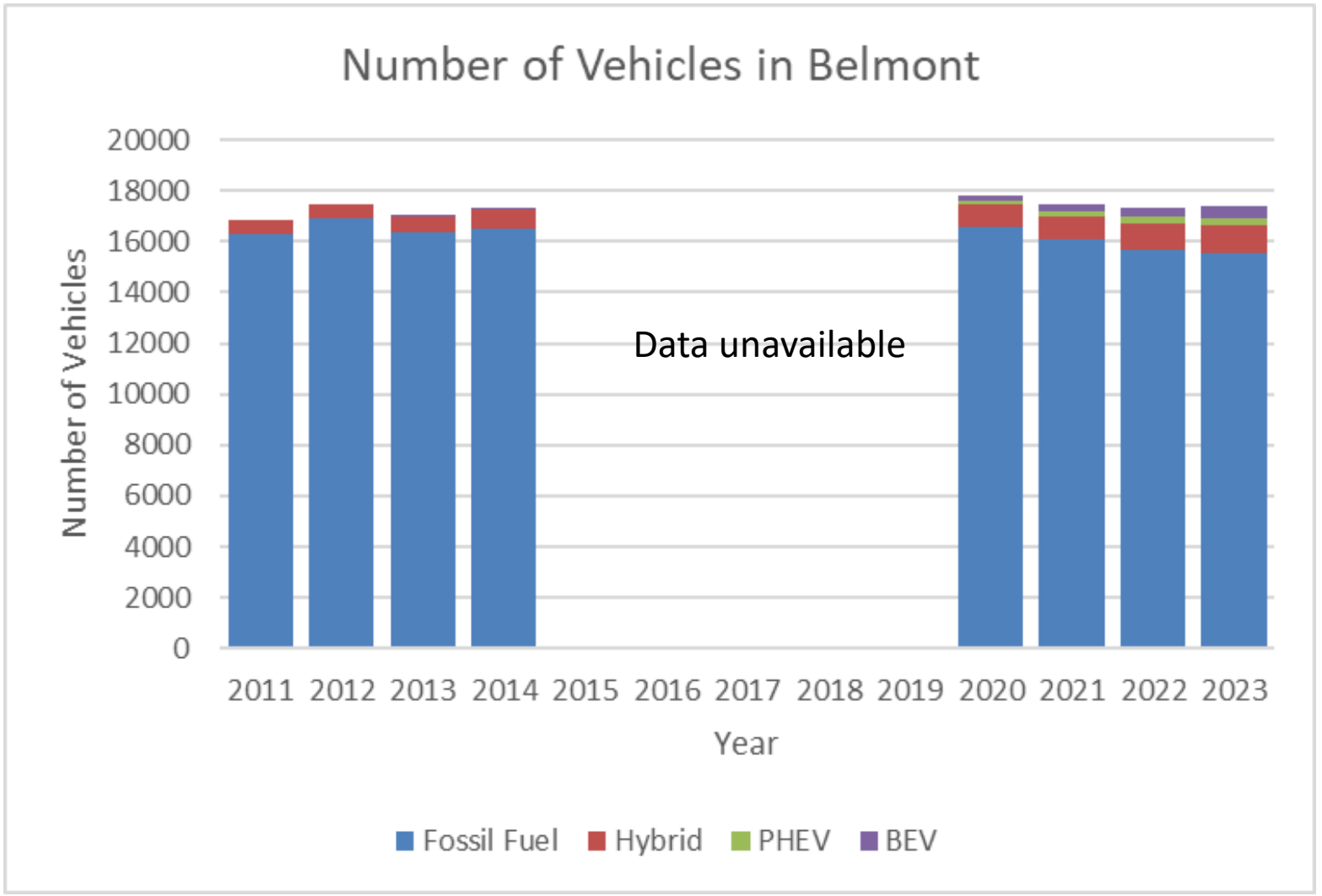
- 2014 was year used in last Belmont GHG inventory update
- 2021 is most recent year for which data is mostly available

Considered four principal sources of CO_2 emissions in Belmont:

- Vehicles (gasoline)
- Natural gas
- Fuel Oil
- Electricity

Also looked at recent trends in vehicle electrification

Vehicles

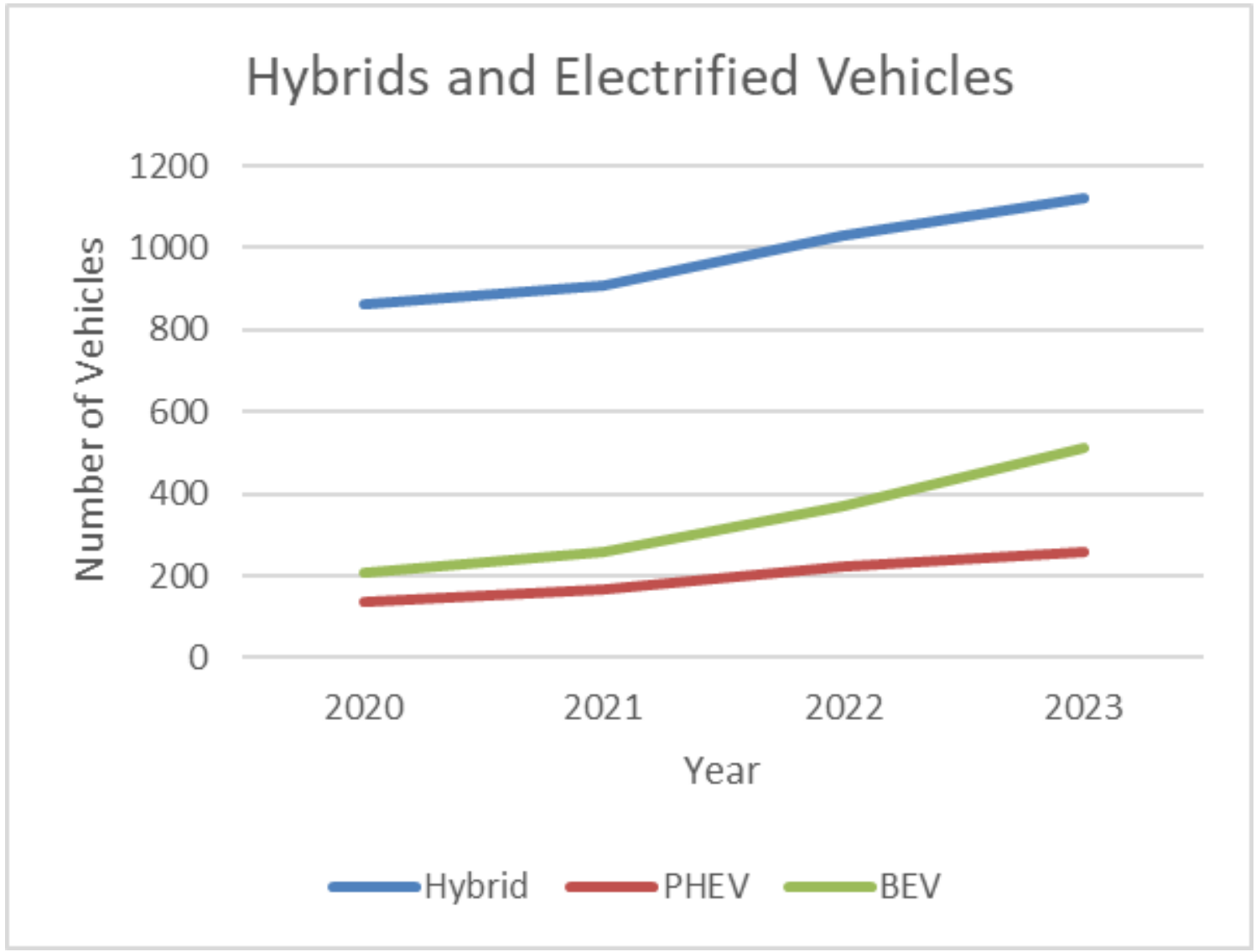


Total number of vehicles registered in Belmont has stayed constant over last twelve years

PHEV: Plug-in Hybrid Electric Vehicle
BEV: Battery Electric Vehicle

Source: Massachusetts Vehicle Census (MAPC, 2011-2014; MassDOT, 2020-2023)

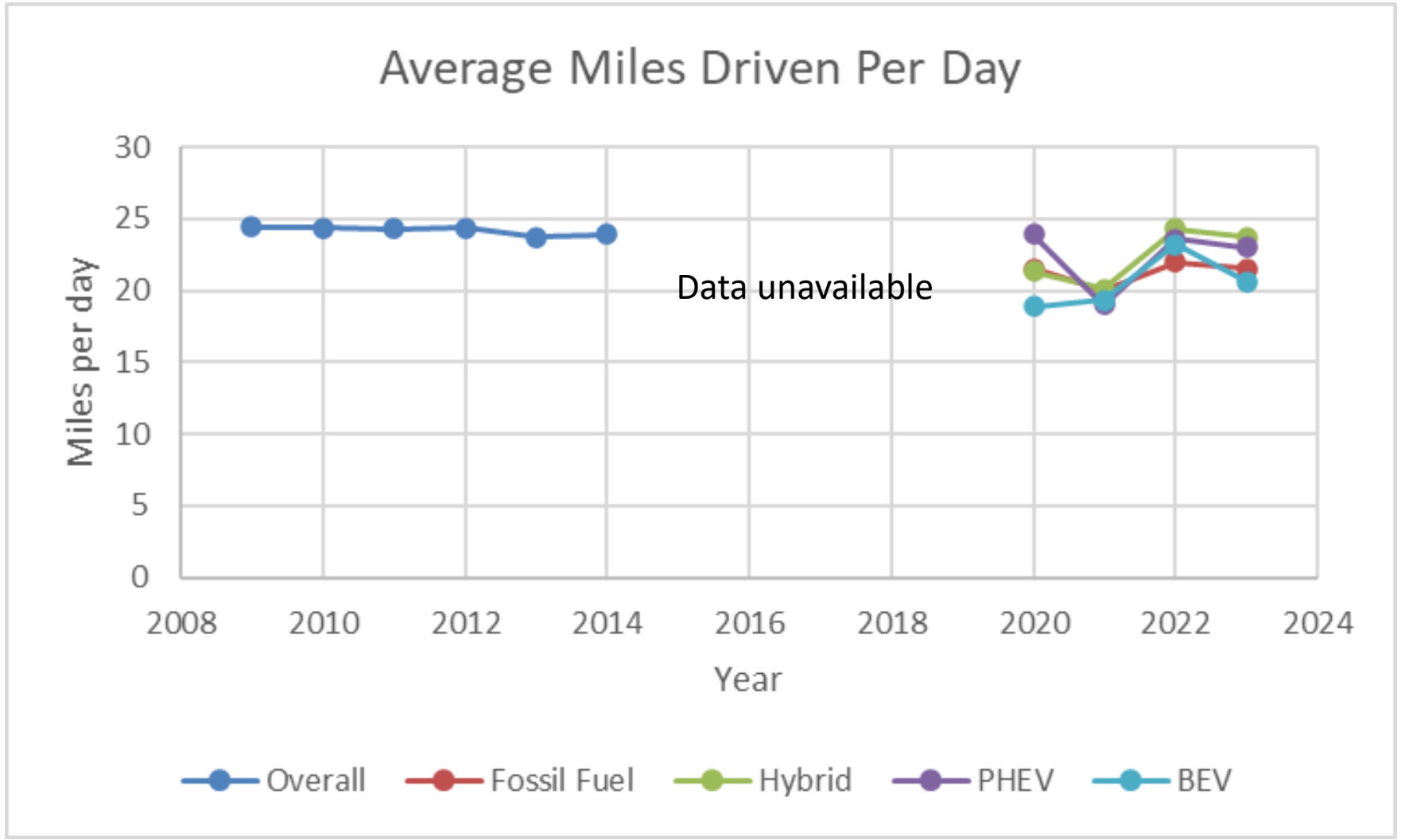
Vehicles



"Hybrid" refers to conventional hybrid (no plug)

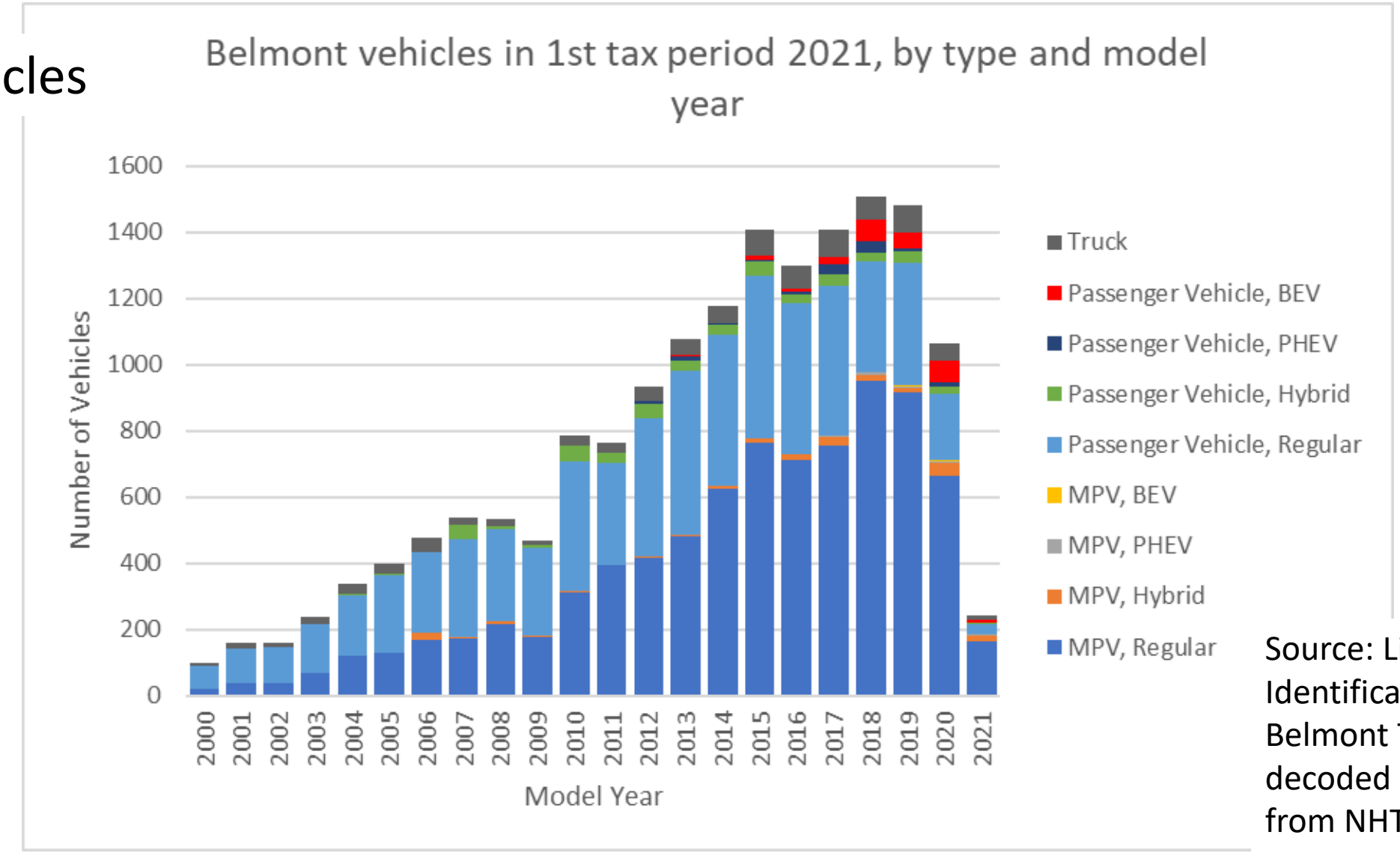
Source: Massachusetts Vehicle Census (MassDOT)

Vehicles



Source: Massachusetts Vehicle Census (MAPC, 2009-2014; MassDOT, 2020-2023)

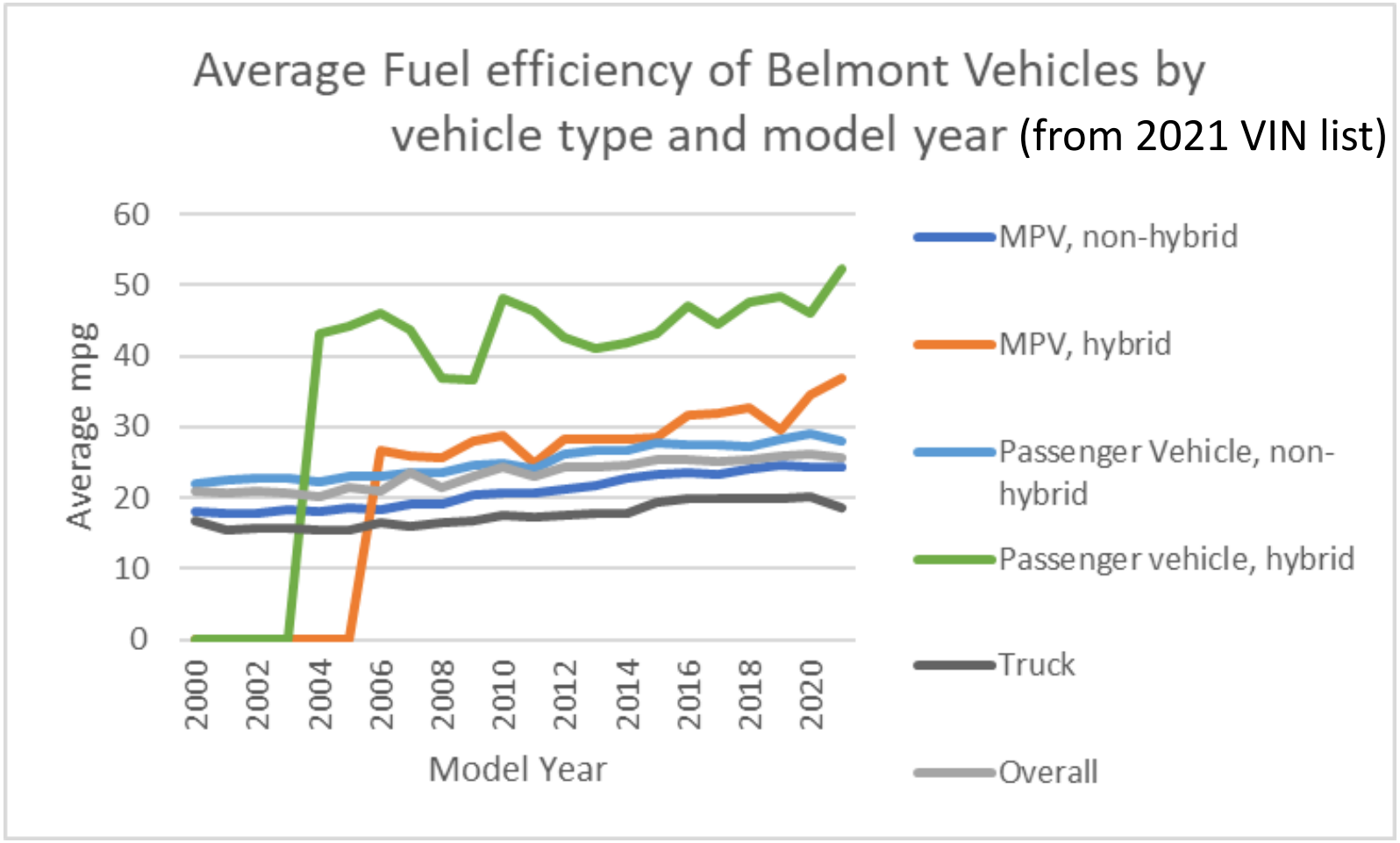
Vehicles



Source: List of Vehicle Identification Numbers from Belmont Town Assessor, decoded using online tool from NHTSA

- "MPV" = Multipurpose Vehicle (SUVs and Wagons); "Passenger Vehicle" = cars
- 92% of vehicles are non-hybrid, fossil-fuel driven ("Regular")
- Recent model year vehicles are predominantly MPVs
- Not shown: vehicles with model year older than 2000, motorcycles

Vehicles



Trend of increasing fuel efficiency in more recent model years

Less improvement in fuel efficiency overall due to the shift toward larger vehicles (MPVs; see previous slide)

Not including electrified vehicles (PHEV and BEV)

Sources: List of Vehicle Identification Numbers (VINs) from Belmont Town Assessors and fuel efficiency data for different vehicles from fueleconomy.gov (USDOE/EPA)

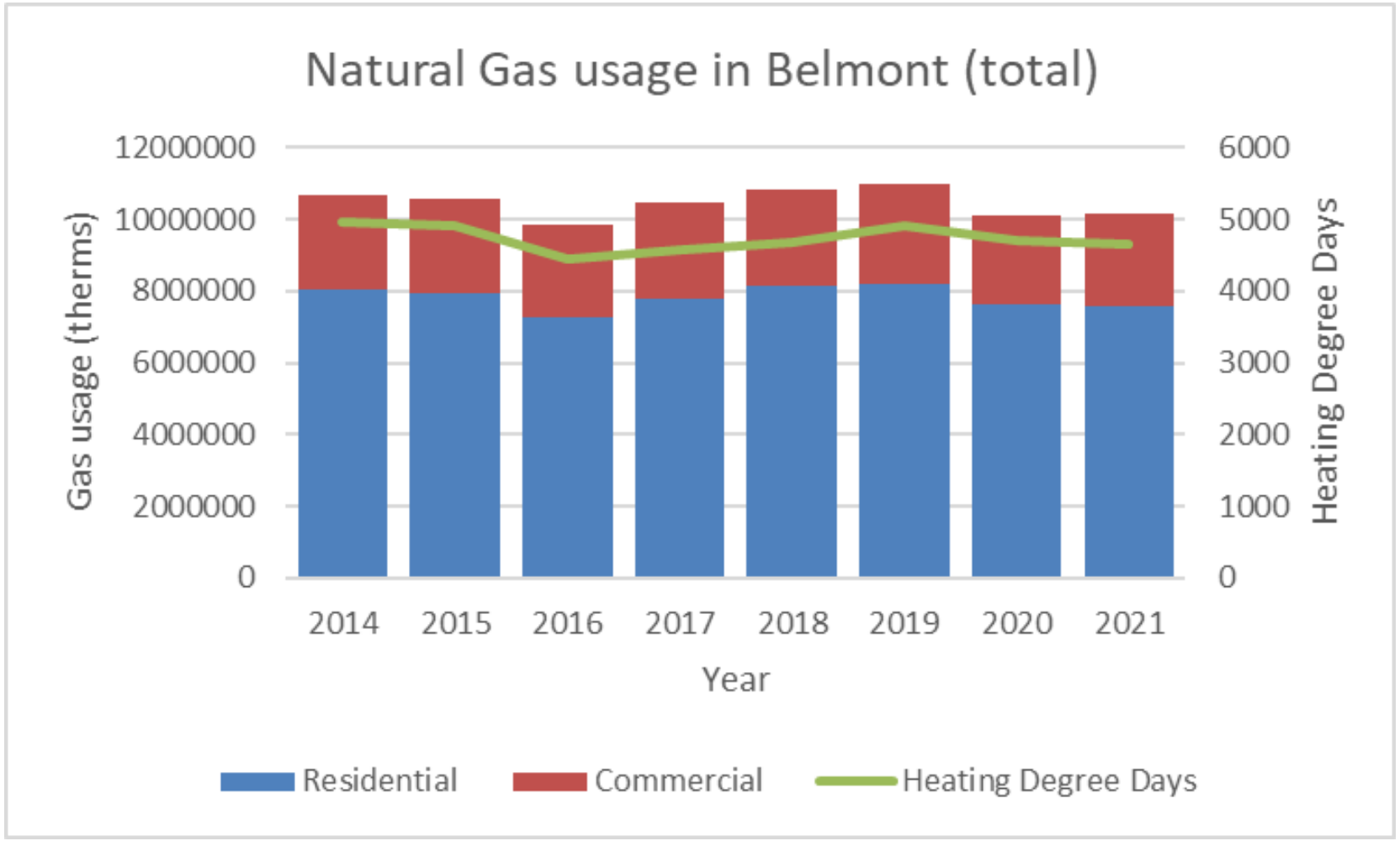
Vehicles

Overall fuel consumption:			
	2014	2021	change
# of non-electrified vehicles	17241	17012	-1%
avg. miles/day	23.9	22.2	-7%
avg. mpg	22.2	24.3	-9%
gallons	6774640	5672767	-16%

Massachusetts Vehicle Census (MAVC)

2021 calculated from fuel efficiency data of 2021 fleet, 2014 from MAVC data. Change expressed as change in fuel *consumption* (gallons per mile)

Heating fuels



Total natural gas usage (including space and water heating)

Usage is largely flat; fluctuates year-to-year in parallel with total heating degree days, a measure of heating load

Sources: masssavedata.com (data provided by National Grid), weatherdatadepot.com

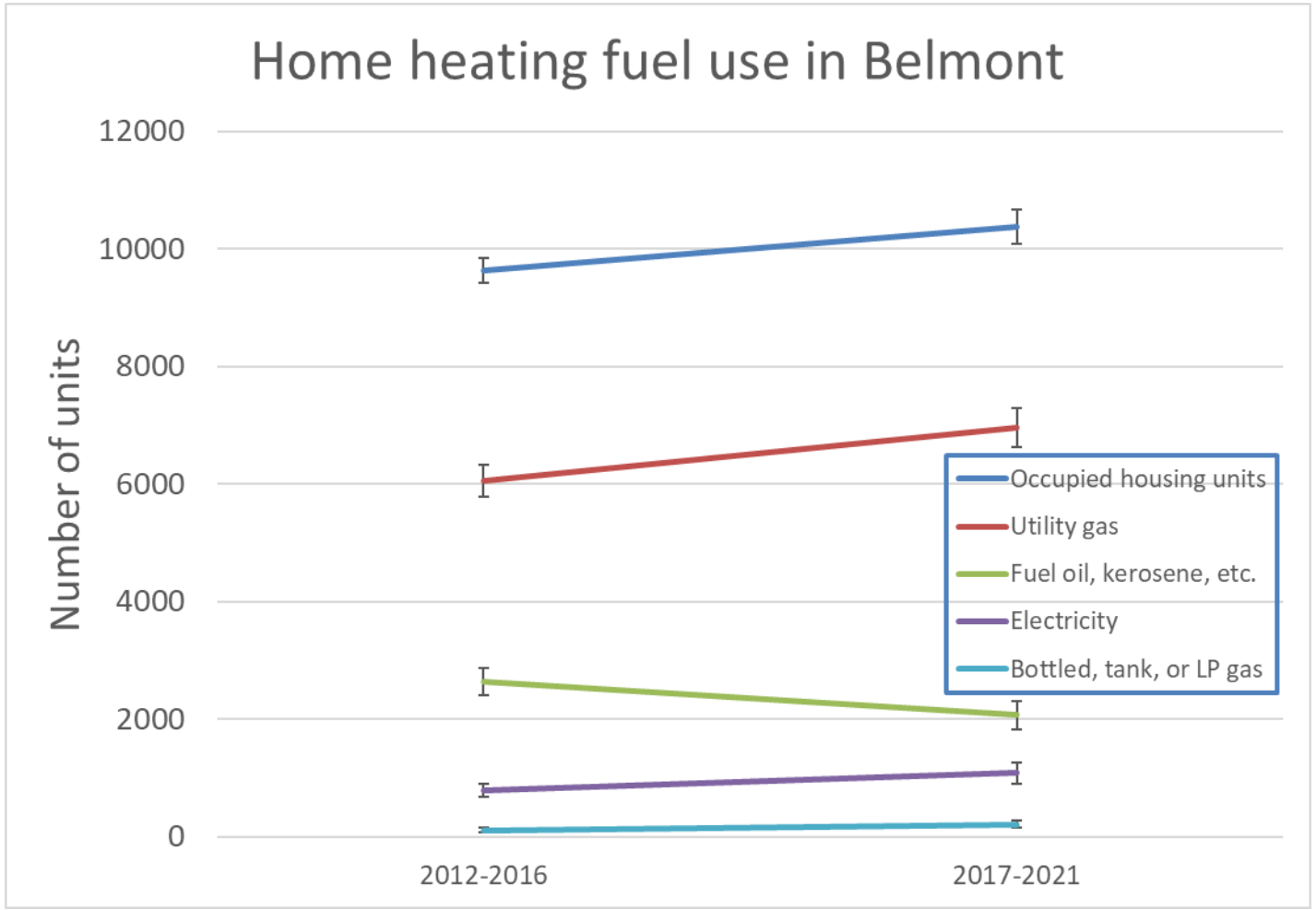
Heating fuels

Fuel Oil

Fuel oil usage is more difficult to assess due to the multiplicity of vendors.

Approach taken: estimate number of households using oil for heat in Belmont from census data

Heating fuels



5-year estimates derive from census data collection over the entire period

Error bars show margin of error (90% confidence interval)

Source: American Community Survey, 5-year estimates (US Census)

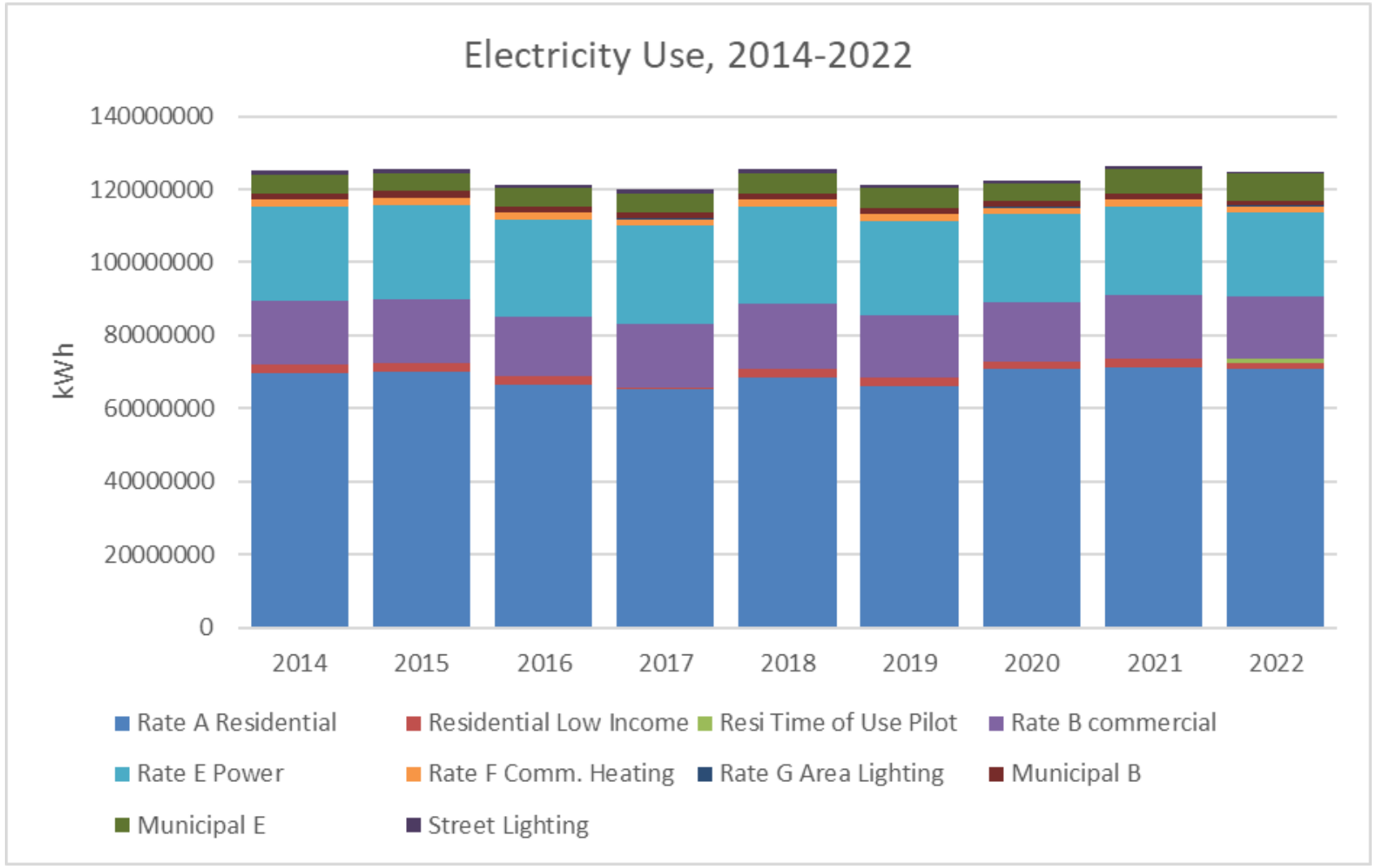
Heating fuels

Estimated oil usage:	2014	2021	Change
housing units	2639	1835	
gallons per unit	673	673	
total gallons fuel oil	1776047	1235224	-30%

Estimate total number of households heated by oil as:

- 2639 in 2014 (based on 5-year ACS estimate for 2012-2016, with 2014 as midpoint year)
- 1835 in 2021 (estimating 2019 usage based on 2017-2021 and extrapolating trend forward)
- *assume* average 673 gallons of fuel oil use/year/household based on distribution of housing types in Belmont (Source: MAPC GHG inventory tool)

Electricity



Total electricity usage stayed flat

Source: Belmont Light annual DPU reports

Electricity

How much of total electricity use may be attributed to newly electrified transportation and heating? Some estimates for 2022:

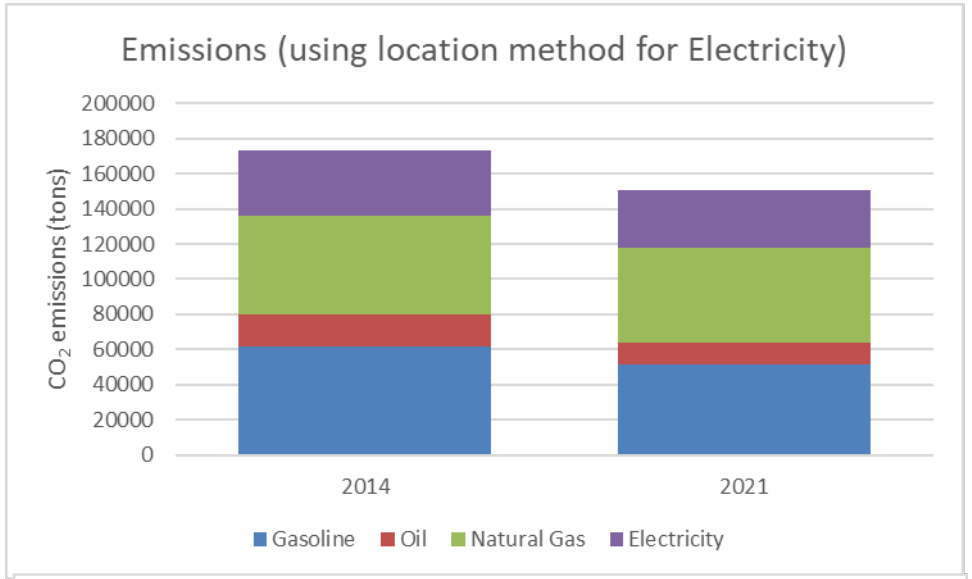
	% of Belmont Light 2022 total	Assumptions
BEVs	0.6%	based on number of vehicles and miles driven; assume all charging occurs in Belmont, 4 mile/kWh efficiency
PHEVs	< 0.4%	0.4% if driven entirely in electric mode
Heat Pumps	< 2%	increase by ~300 of # of units heated with electricity between census periods; assume all of this heating is with heat pumps, using 8500 kWh for heating season

Electricity

There are two approaches to reporting CO_2 emissions from electricity use:

- **location-based** method (based on emissions intensity of the local electric grid)
- **market-based** method (including consideration of ownership of renewable energy certificates (RECs))

Overall CO_2 Emissions



Using ISO-NE grid average emissions factors (kg CO_2e/MWh)

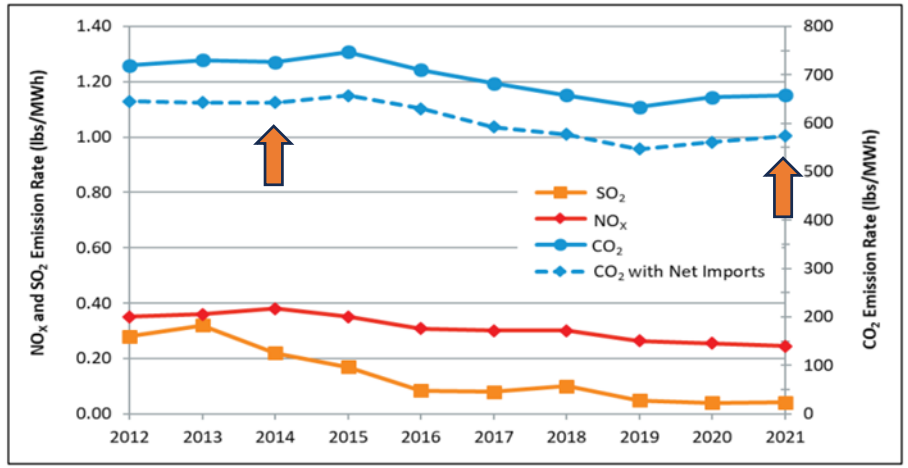
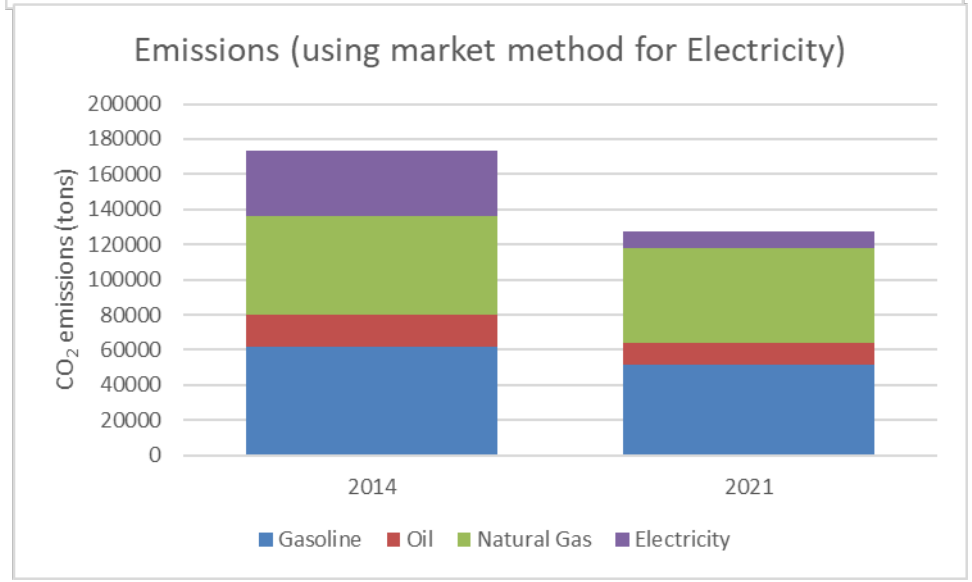


Figure 5-4: ISO New England annual average emission rates, 2012 to 2021 (lbs/MWh).



Using Belmont Light non-emitting purchases (including RECs)

Belmont Light Power Purchase Policy: 83% non-emitting in 2021, assumed remainder was generated by gas with emissions factor of 970 lbs CO_2e/MWh (EIA, US average). Used ISO-NE average emission factor for 2014.

Summary of comparison of 2014 and 2021 CO_2 emissions:

Natural Gas:

- Drop in emissions of 5%, but this is within range of annual variation and 2021 had a warmer heating season
- Little change despite apparent ~15% increase in number of households heated with gas from census data

Fuel Oil:

- Estimated emissions dropped ~30% due to shift of households away from heating with oil
- Commercial fuel oil use unknown

Vehicles:

- number of fossil-fuel-powered vehicles stayed approximately constant
  - electrified vehicles only ~2% of total vehicles in 2021; increasing in last few years
- 7% decline in miles traveled and 9% drop in fuel consumption per mile -> reduction in emissions of 16%

Electricity:

- Overall usage in kWh stayed flat
- Reduction in CO_2 emissions:
  - 12% if using location-based accounting for emissions from electricity use, due to reduced carbon intensity of New England grid, OR
  - 75% if using market-based accounting for emissions from electricity use, due to Belmont Light non-emitting energy purchases