



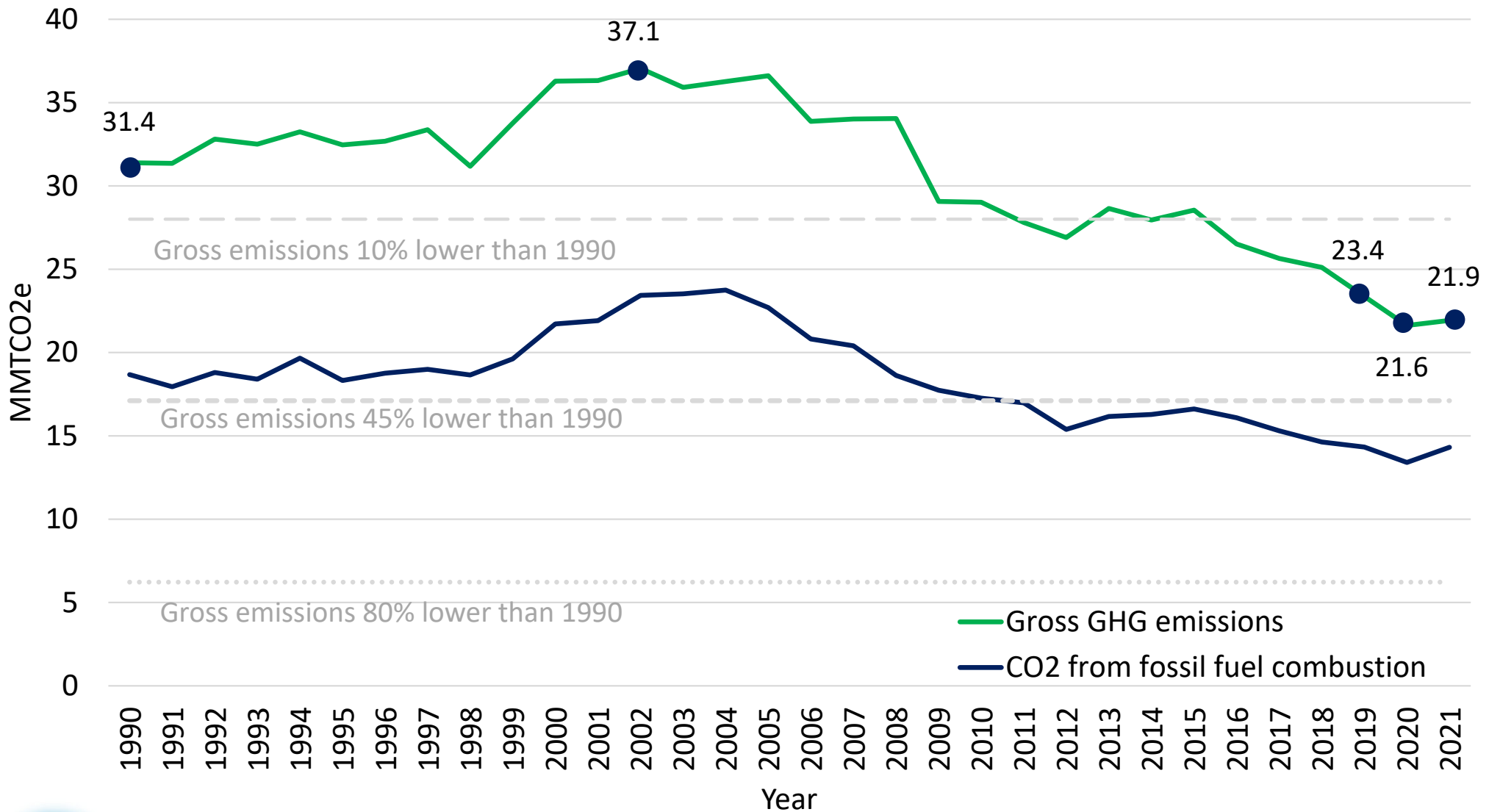
June 2024 update Progress toward Greenhouse Gas Reduction Goals

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MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

Protecting Maine's Air, Land and Water

Gross 2021: 30% lower than 1990



Methods, data sources & units

- Chapter 167
 - Tracking and Reporting Gross and Net Annual Greenhouse Gas Emissions
 - <https://www.maine.gov/dep/air/rules/index.html>
- EPA State Inventory Tool (SIT): 2009 – 2021
 - <https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool>
- Energy Information Administration (EIA)
 - Consumption: Billions of British thermal units (BBtu)
- State inputs & additions
 - E.g., vehicle miles traveled (VMT), solid waste landfilled, biogenic emissions, etc.



Methods, data sources & units

- Net inventory (carbon budget)
 - University of Maine, Bates College, Maine Forest Service, Gulf of Maine Research Institute, Bigelow Laboratories, and Maine Natural Areas Program, Maine DEP
 - Difference between carbon emitted and carbon sequestered
- MMTCO₂: CO₂ (from fossil fuel combustion)
 - Energy sector: residential, commercial, industrial, transportation, electric power
- MMTCO₂e: CO₂, CH₄, N₂O, HFC, PFC, SF₆
 - Source category: energy, agriculture, waste, industrial processes



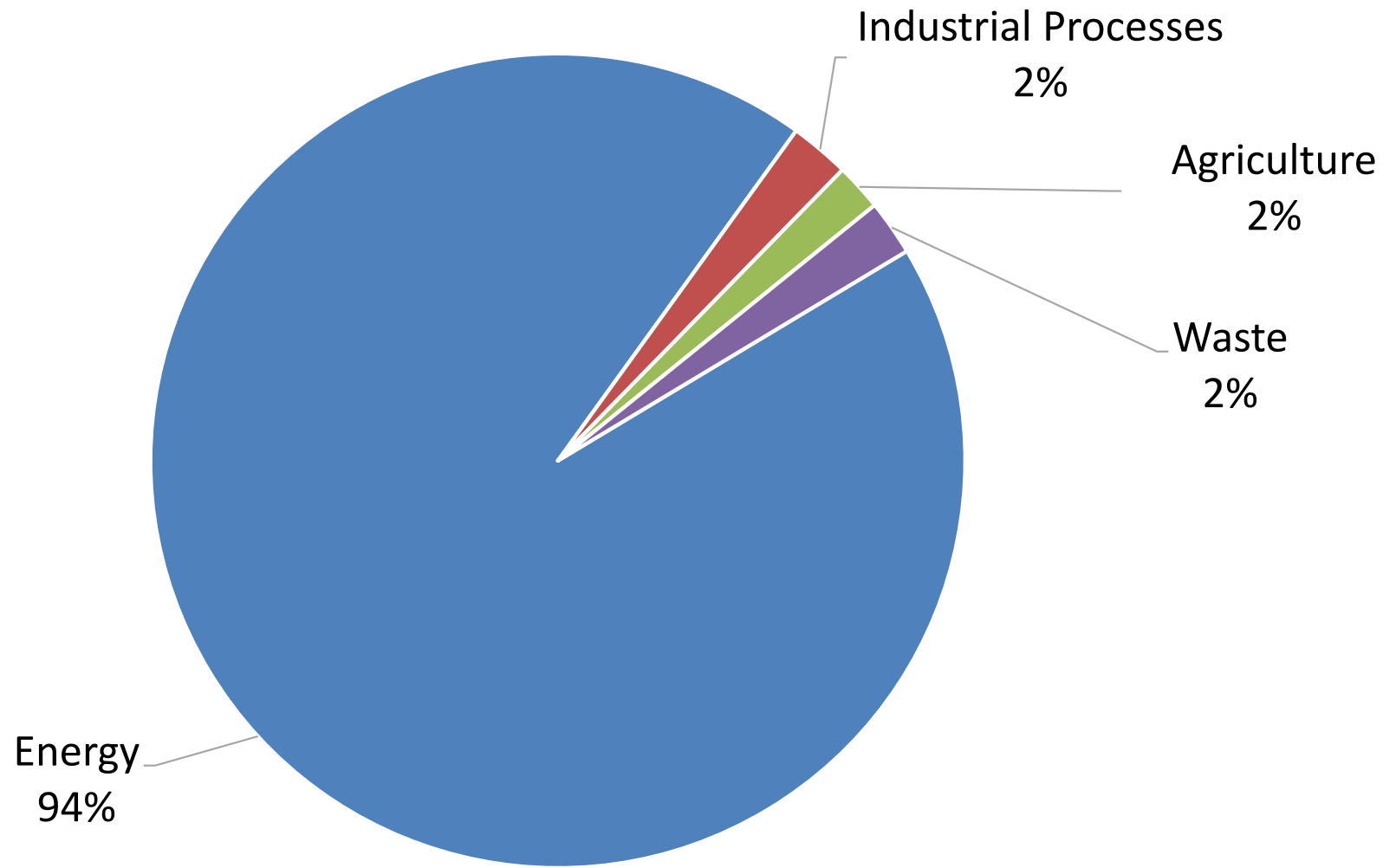
Source categories & energy sectors (Table A4)

Table A4. Maine's Gross Greenhouse Gas Emissions by Energy Sector with Source Category (MMTCO₂e; 1990 - 2021)

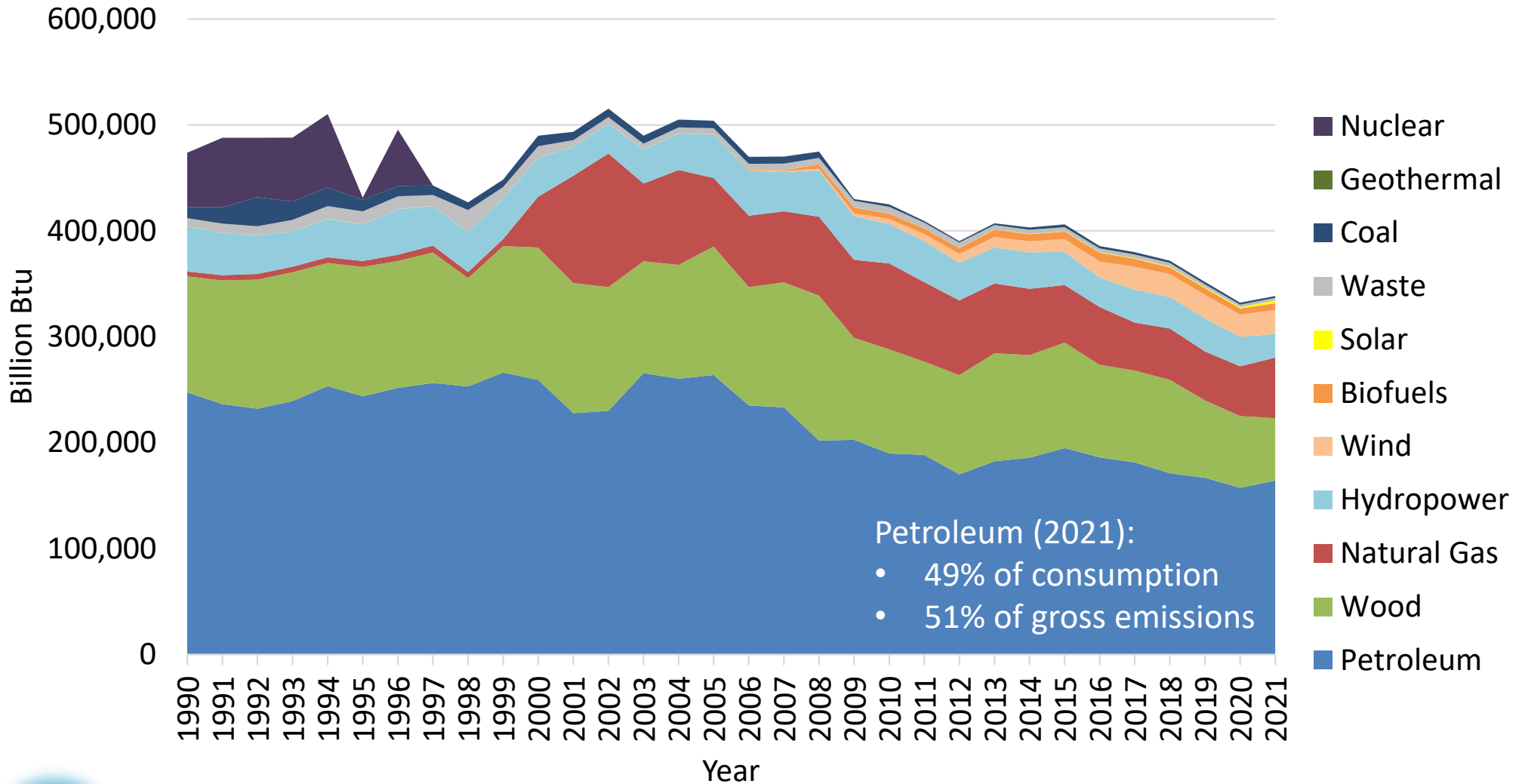
	Source category	1990	2000	2010	2015	2019	2020	2021
ENERGY SECTOR EMISSIONS TOTAL		29.38	29.10	33.62	27.15	26.97	21.76	20.16
Residential Total		4.21	5.19	3.97	4.63	4.84	4.64	4.19
Fossil fuel combustion CO ₂	Energy	2.99	3.94	2.67	3.05	3.03	2.87	2.67
Fossil fuel combustion CH ₄ & N ₂ O	Energy	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Wood combustion	Energy (biogenic)	1.20	1.23	1.29	1.56	1.79	1.76	1.51
Commercial Total		2.34	1.99	1.92	2.14	2.10	1.92	2.04
Fossil fuel combustion CO ₂	Energy	2.23	1.91	1.72	1.78	1.77	1.61	1.75
Fossil fuel combustion CH ₄ & N ₂ O	Energy	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ethanol combustion	Energy (biogenic)	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Wood combustion	Energy (biogenic)	0.09	0.07	0.19	0.34	0.30	0.29	0.27
Industrial Total		10.41	12.29	7.76	6.85	5.74	5.03	4.33
Fossil fuel combustion CO ₂	Energy	3.09	3.72	2.18	1.53	1.55	1.57	1.51
Fossil fuel combustion CH ₄ & N ₂ O	Energy	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Ethanol combustion	Energy (biogenic)	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Wood combustion	Energy (biogenic)	7.31	8.55	5.57	5.31	4.18	3.46	2.82
Transportation Total		8.27	8.64	8.33	9.08	7.63	7.04	7.52
Fossil fuel combustion CO ₂	Energy	8.02	8.37	7.86	8.49	7.13	6.58	7.03
Fossil fuel combustion CH ₄ & N ₂ O	Energy	0.25	0.27	0.14	0.10	0.08	0.08	0.08
Ethanol combustion	Energy (biogenic)	0.00	0.00	0.33	0.42	0.36	0.33	0.37
Biodiesel combustion	Energy (biogenic)	0.00	0.00	0.00	0.07	0.05	0.06	0.04
Electric Power Total		3.88	5.52	5.18	4.27	1.46	1.53	2.29
Fossil fuel combustion CO ₂	Energy	2.06	3.51	2.58	1.58	0.71	0.70	1.26
Fossil fuel combustion CH ₄ & N ₂ O	Energy	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Wood combustion	Energy (biogenic)	1.81	2.01	2.60	2.69	0.74	0.83	1.02
NON-ENERGY SECTOR EMISSIONS TOTAL								
Natural gas distribution system CH ₄ fugitive emissions	Energy	0.04	0.04	0.03	0.04	0.04	0.04	0.04
CO ₂ from combustion of international bunker fuels	Energy	0.28	0.27	0.27	0.19	0.13	0.08	0.10
Industrial processes	Industrial processes	0.67	0.80	0.53	0.41	0.46	0.41	0.52
Agriculture	Agriculture	0.52	0.53	0.56	0.47	0.49	0.46	0.41
Wastewater	Waste	0.15	0.17	0.17	0.16	0.16	0.16	0.16
Municipal solid waste	Waste	0.40	0.60	0.20	0.21	0.22	0.21	0.21
Solid waste (biogenic CO ₂ emissions)	Waste (biogenic)	0.23	0.26	0.11	0.10	0.09	0.09	0.11
Gross GHG emissions		31.39	36.29	29.02	28.55	23.37	21.63	21.93



Gross emissions by source category (2021)

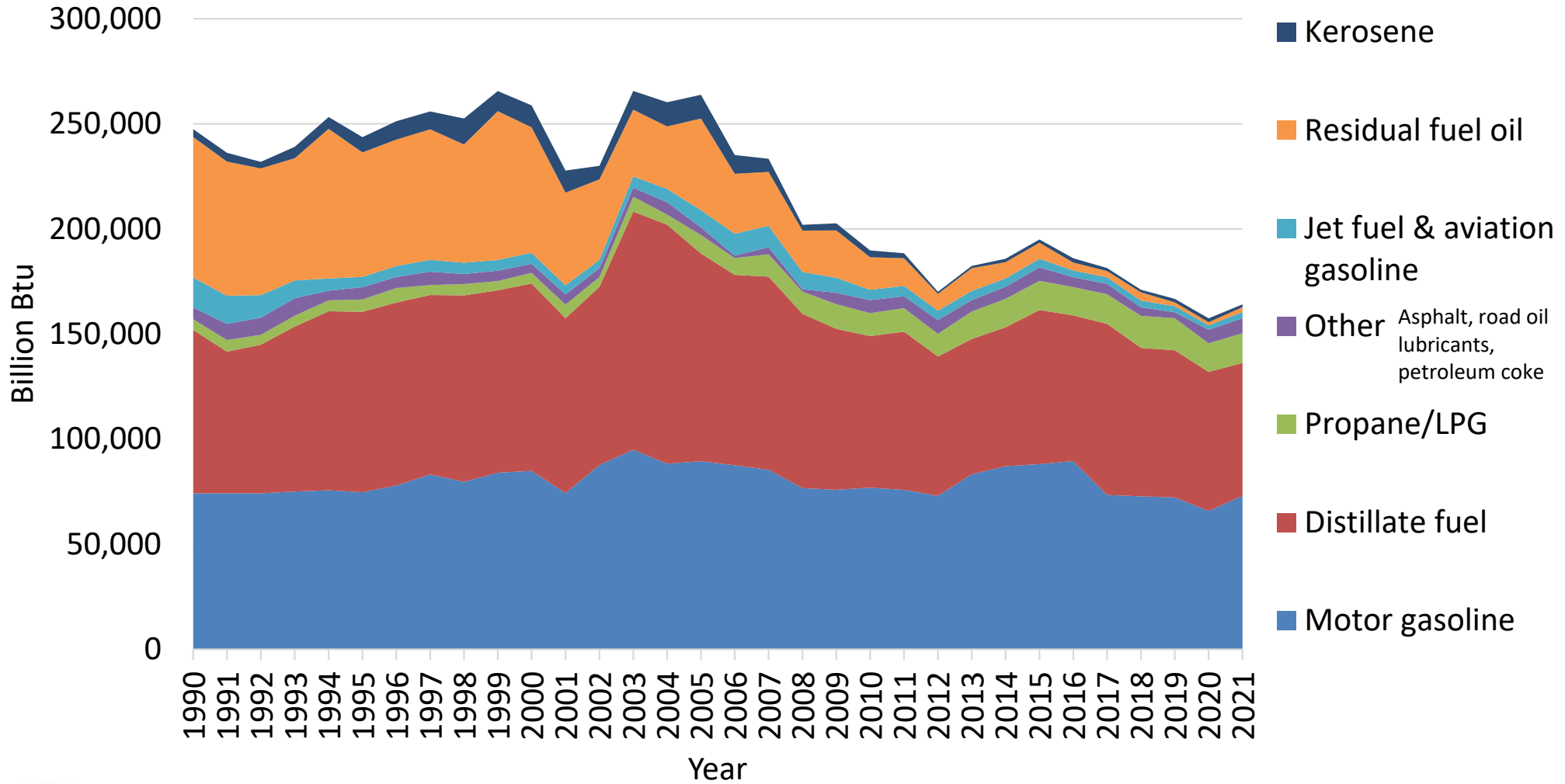


Maine energy consumption: 29% less than 1990

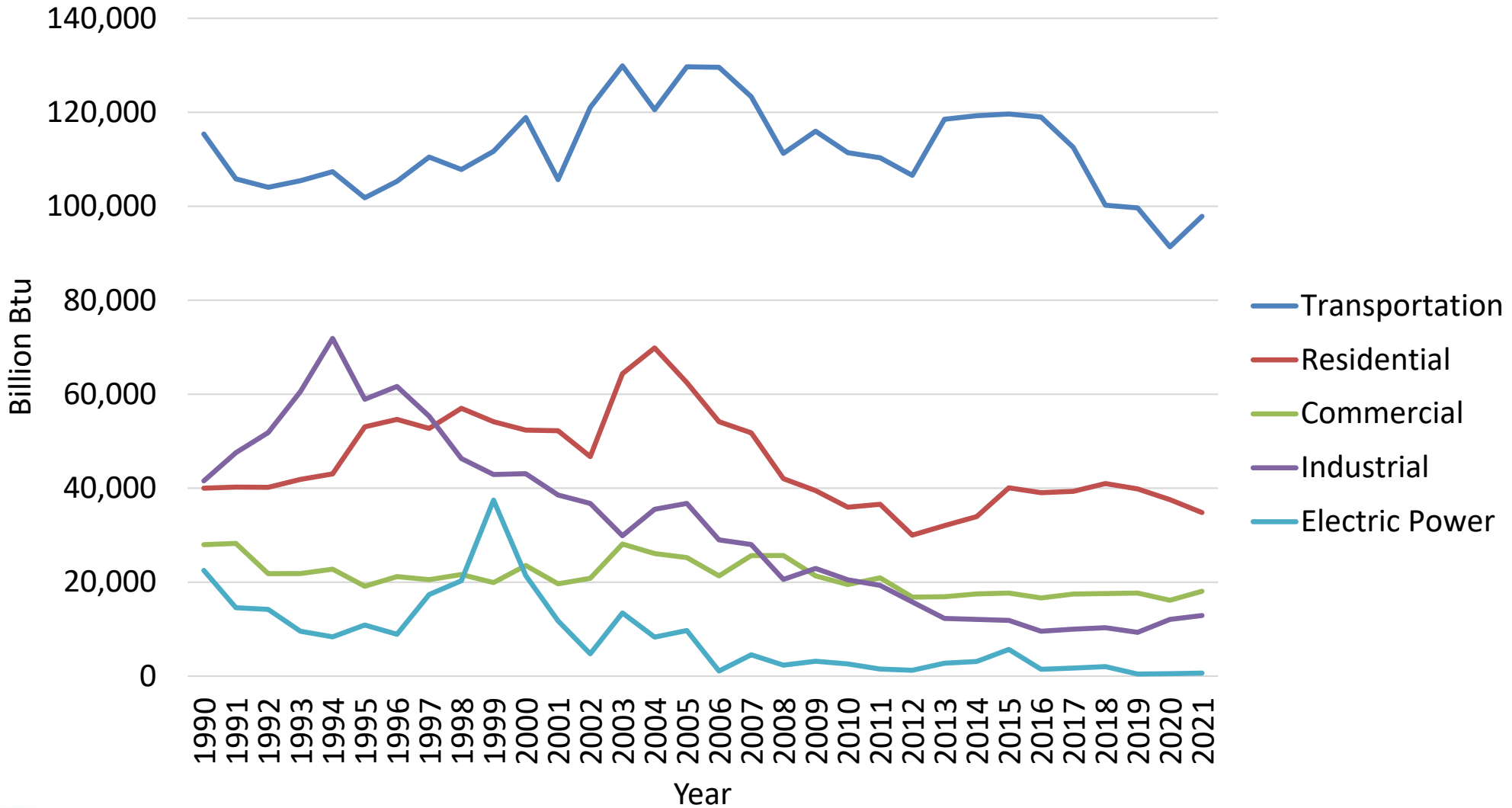


Petroleum consumption by fuel type

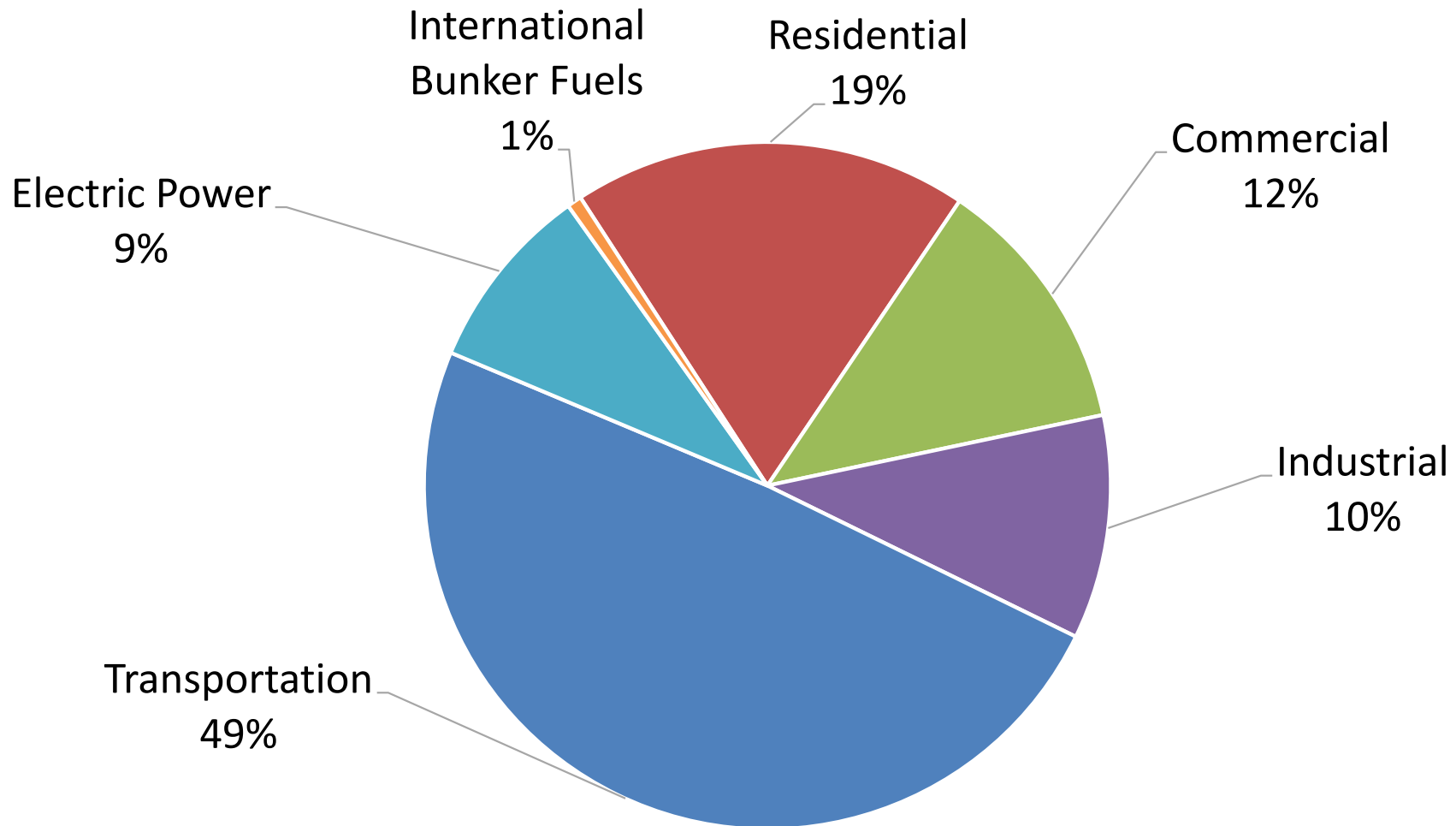
36% decrease in CO₂ emissions since 1990
34% decrease in consumption since 1990



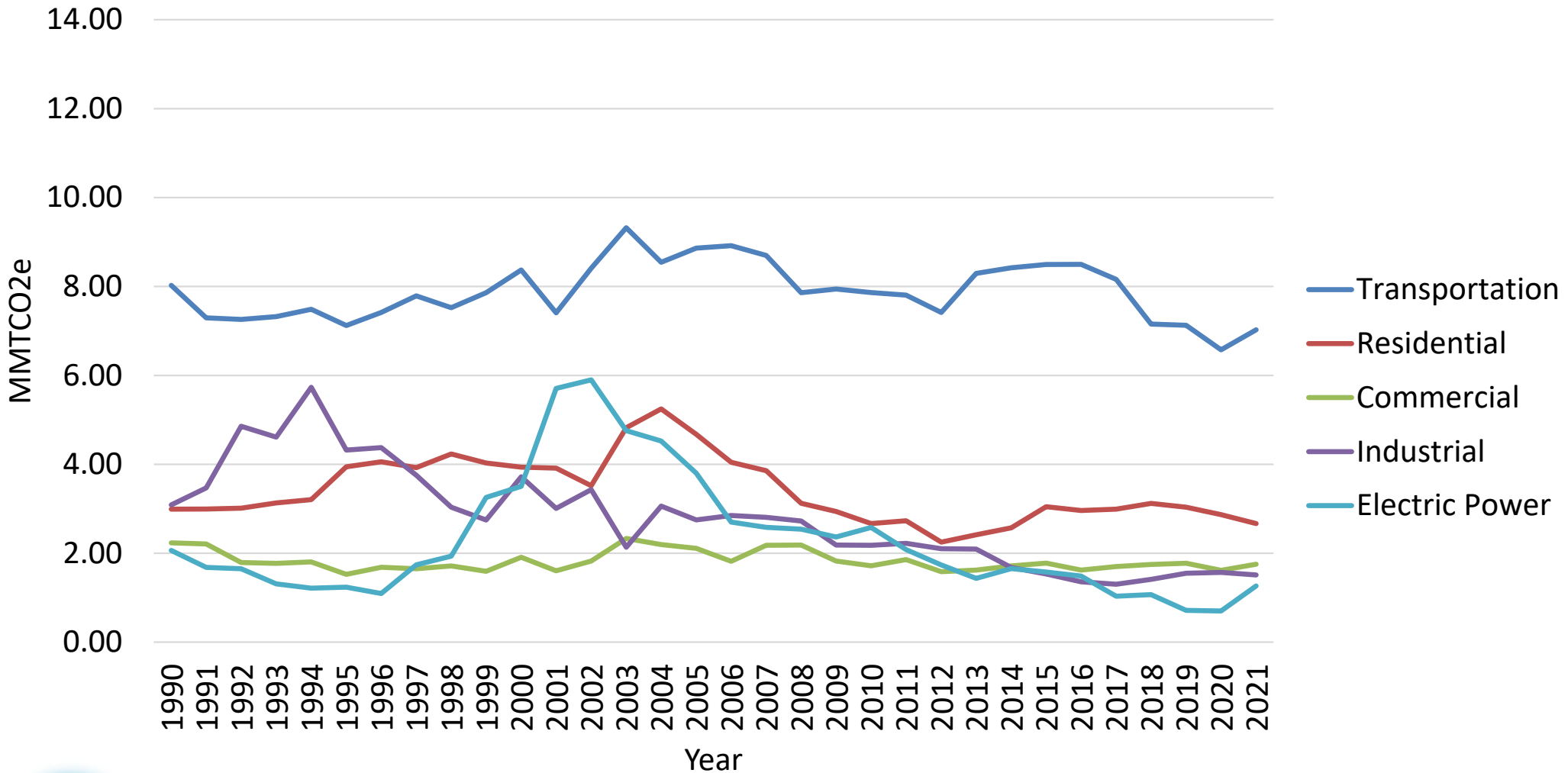
Petroleum consumption by sector



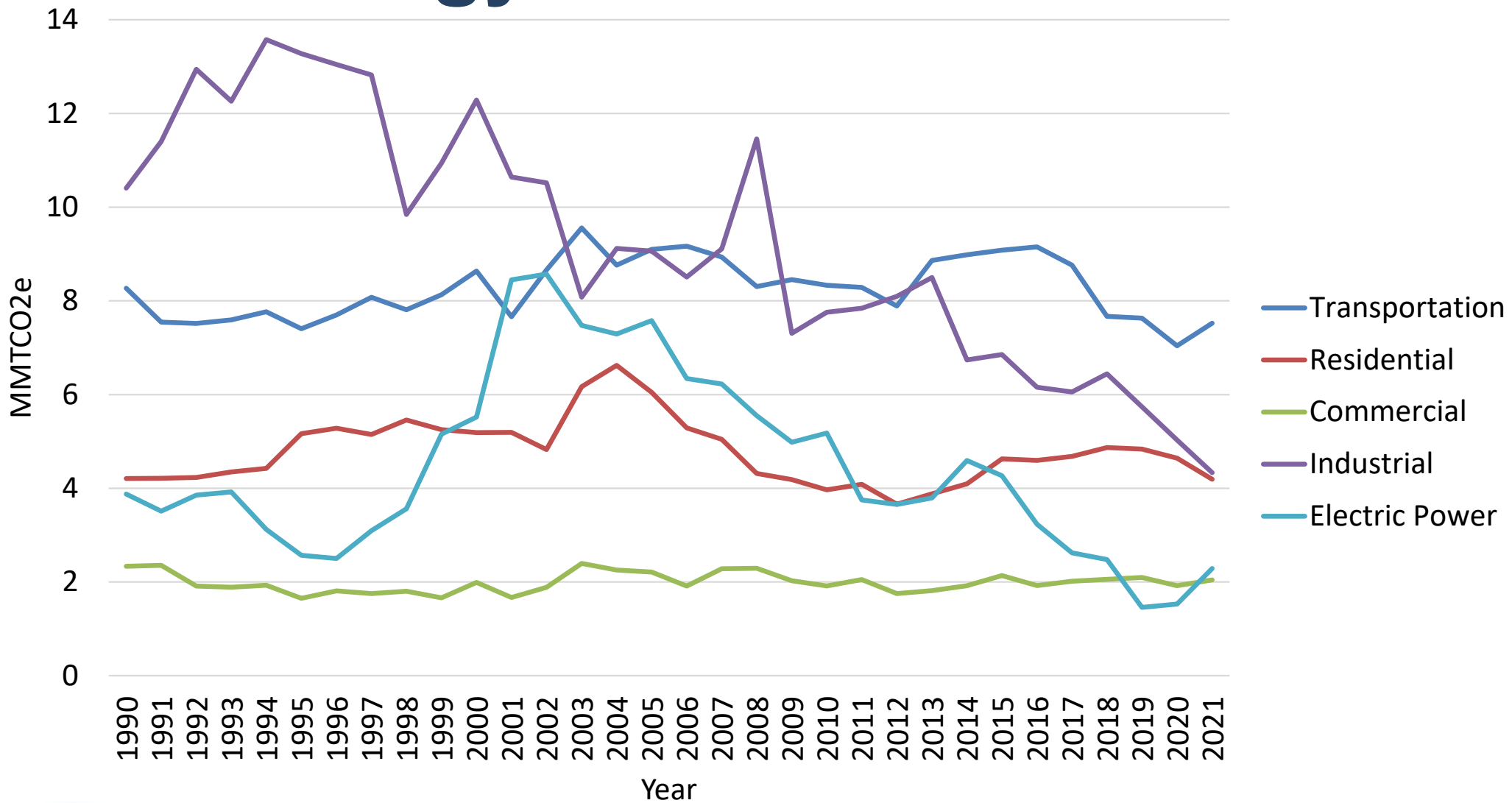
CO₂ emissions from fossil fuel combustion by sector (2021)



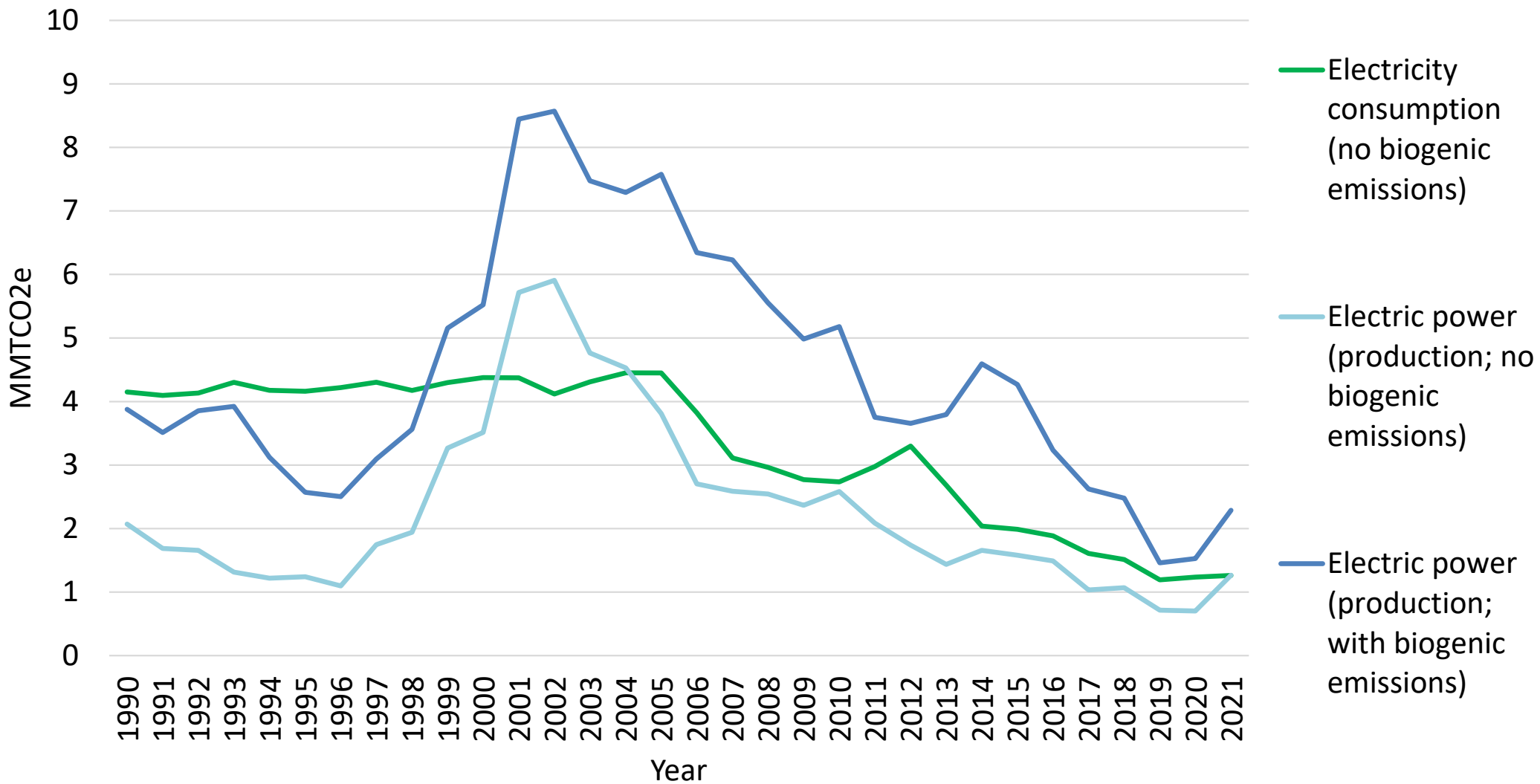
CO₂ emissions from combustion of fossil fuels by energy sector



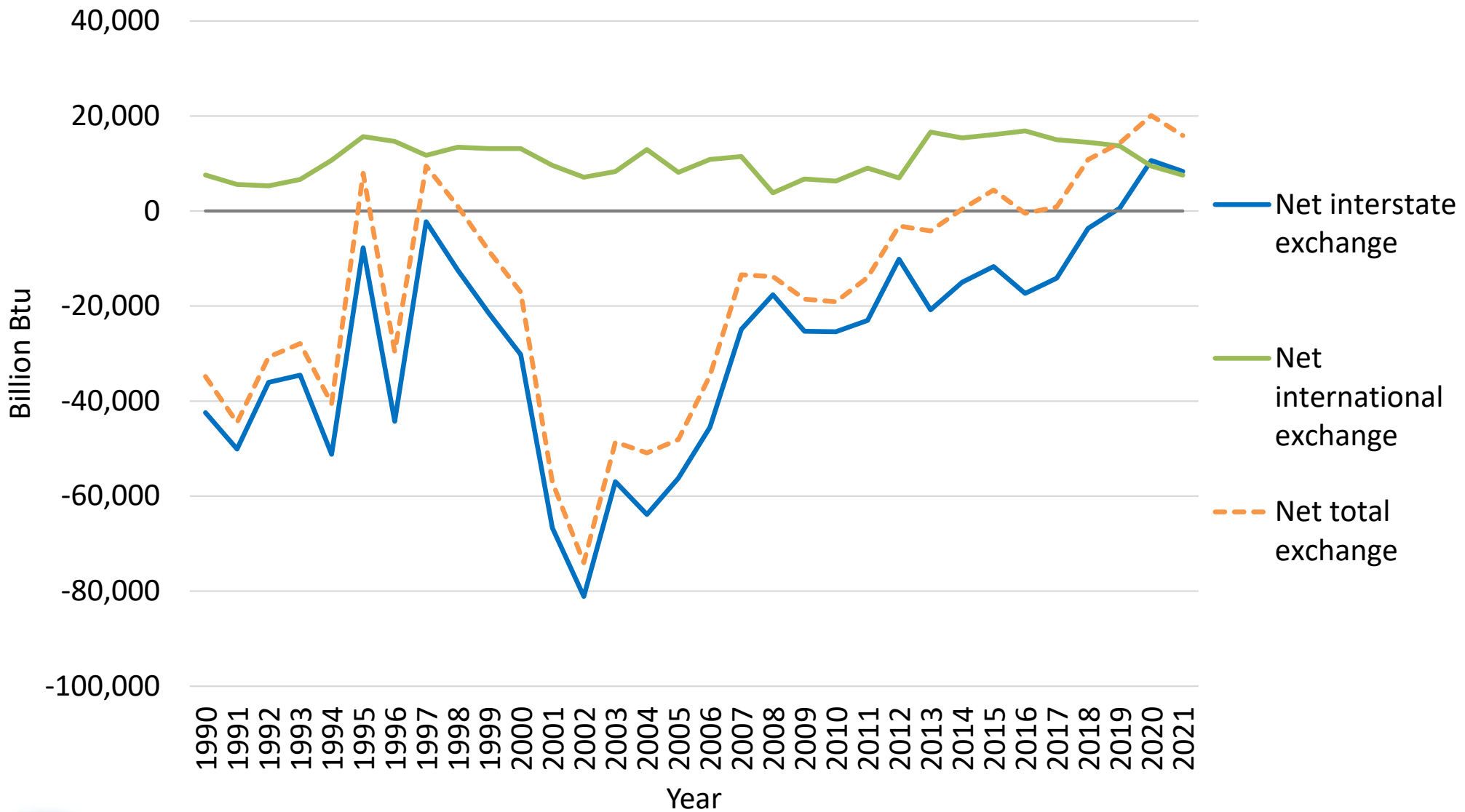
Energy sector emissions



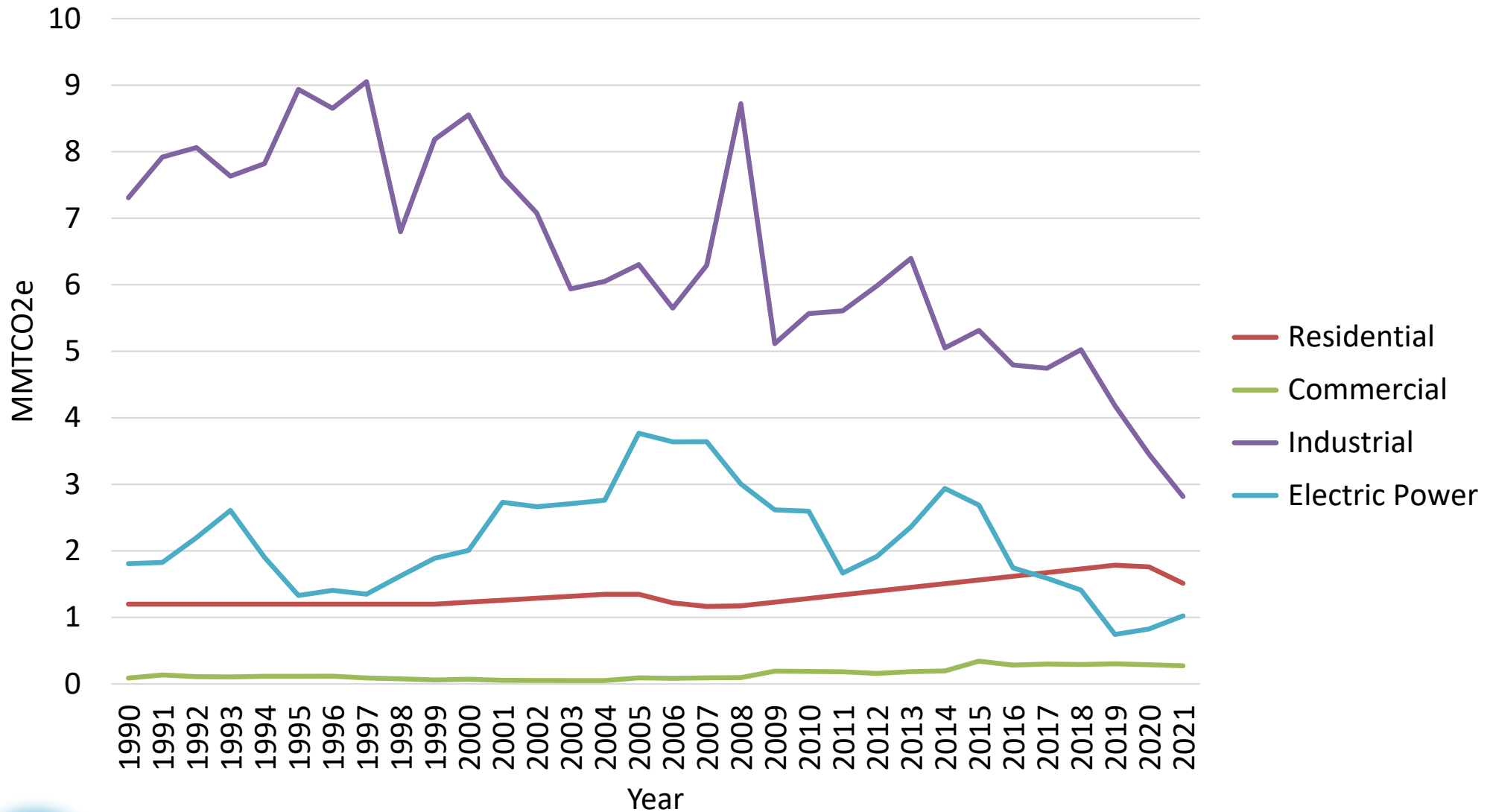
Electricity production vs. consumption



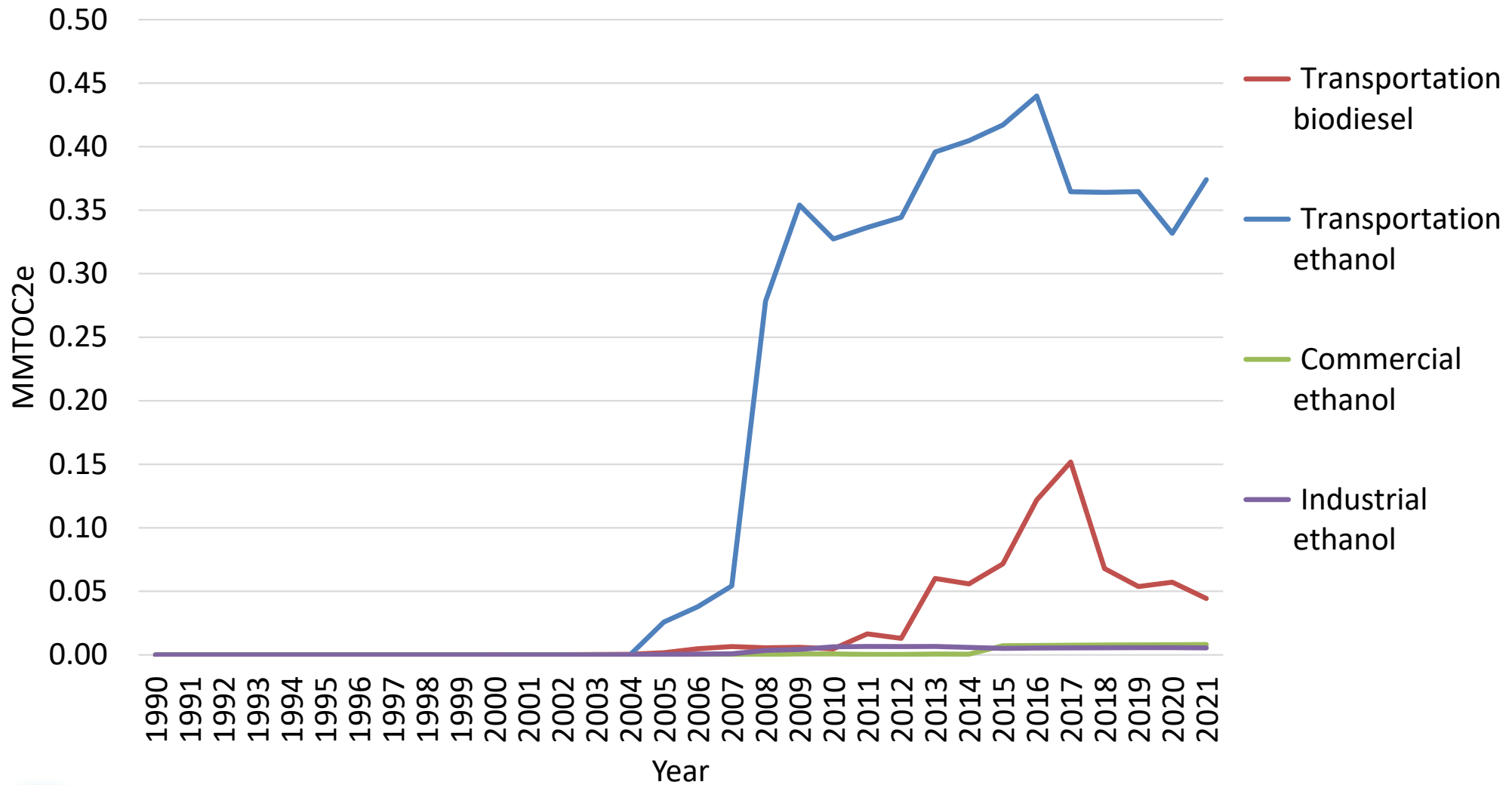
Electricity imports & exports



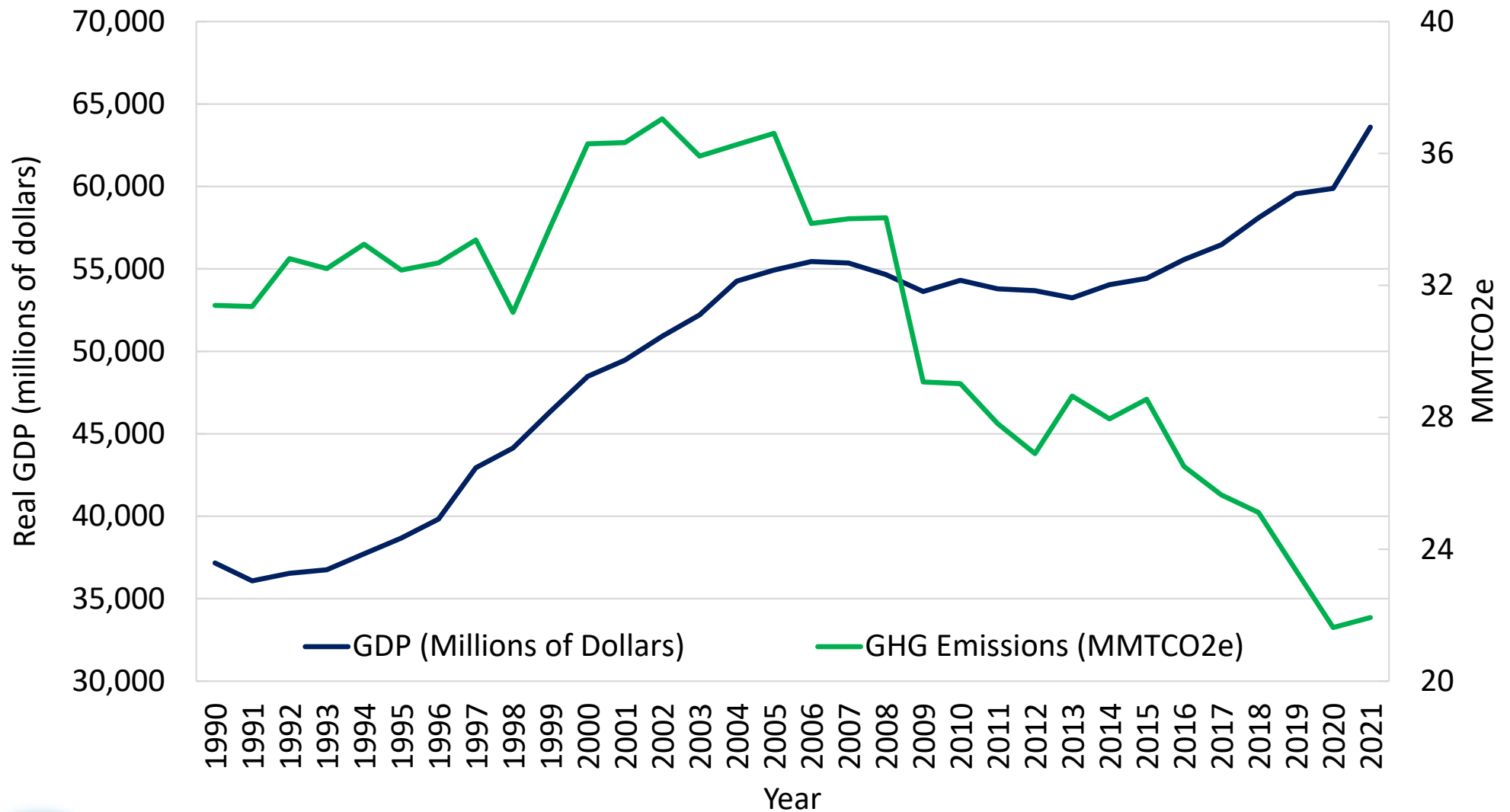
Wood emissions by energy sector



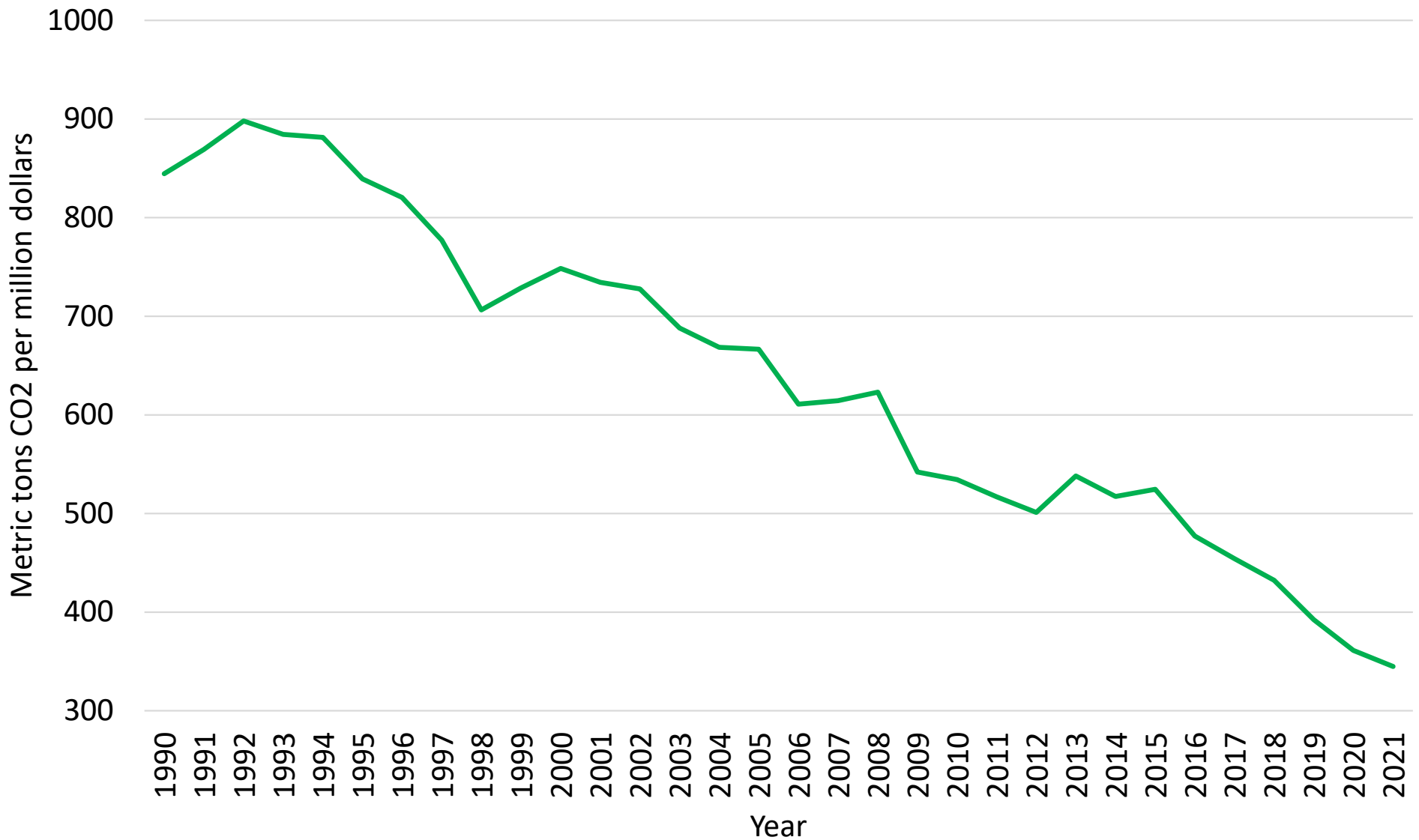
Ethanol & biodiesel emissions by energy sector



Maine GDP & gross GHG emissions

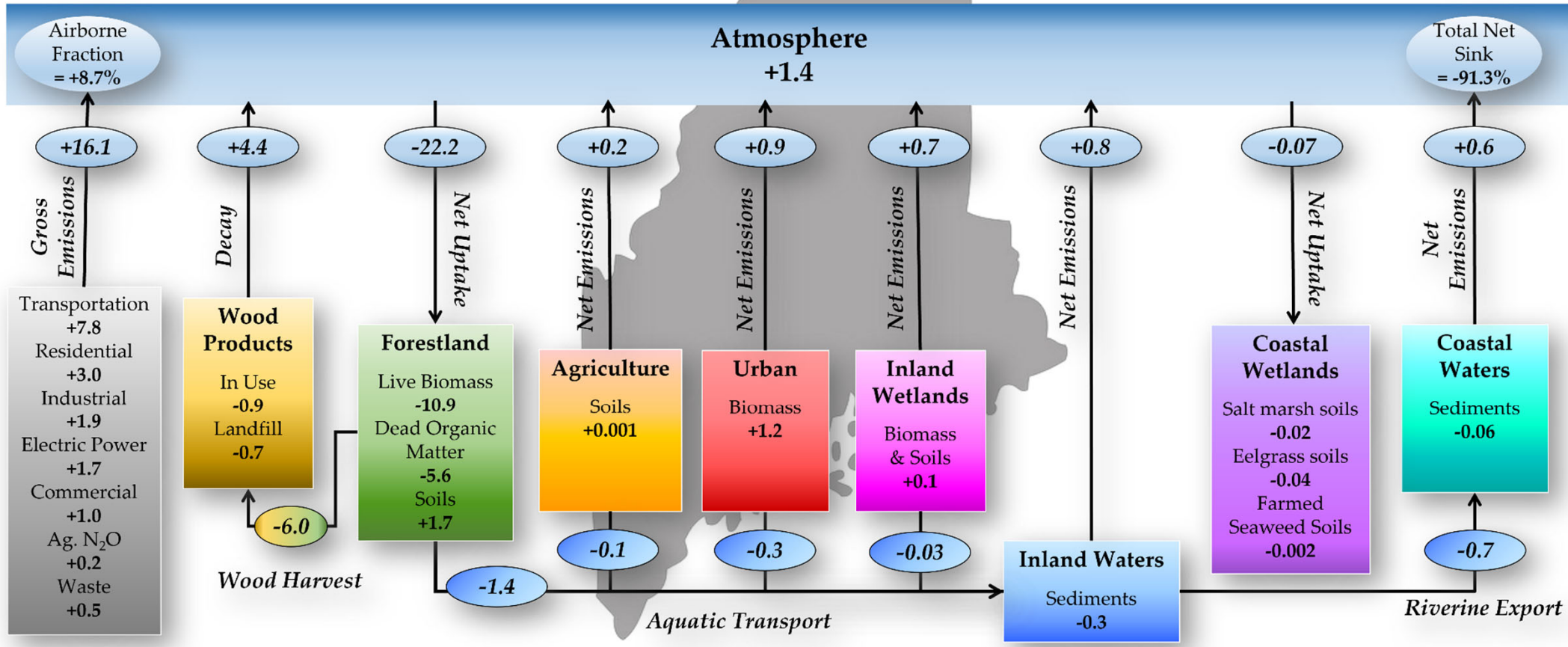


Gross GHG emissions per GDP



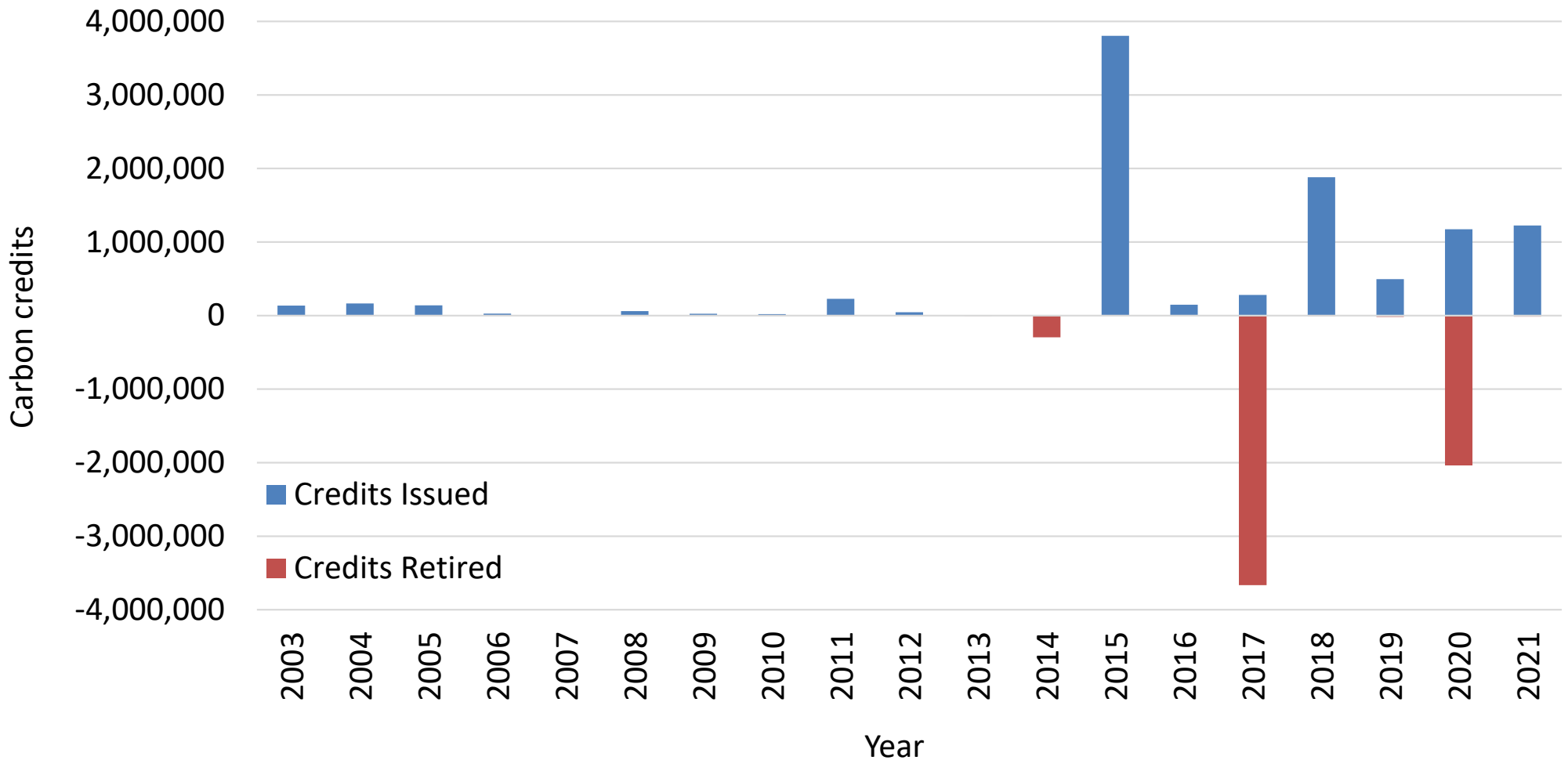
The State of Maine Carbon Budget ca. 2021

Average annual emissions and removals (MMT_{CO₂e} per year) from 2017 to 2021



Hayes, D., Brewer, A., Daigneault, A., Enterline, C., Fernandez, I., Frank, J., Johnson, B., Knapp, S., Legaard, K., Price, N., Puryear, K., Simons-Legaard, E., Stevens, A., Wei, X., Weiskittel, A. (2024). The State of Maine's Carbon Budget (Version 2, 2017 - 2021). <https://crsf.umaine.edu/forest-climate-change-initiative/carbon-budget/>.

Forest carbon markets



Ivy S. So, Barbara K. Haya, Micah Elias. (2023, December). Voluntary Registry Offsets Database v9, Berkeley Carbon Trading Project, University of California, Berkeley. Retrieved from: <https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database>

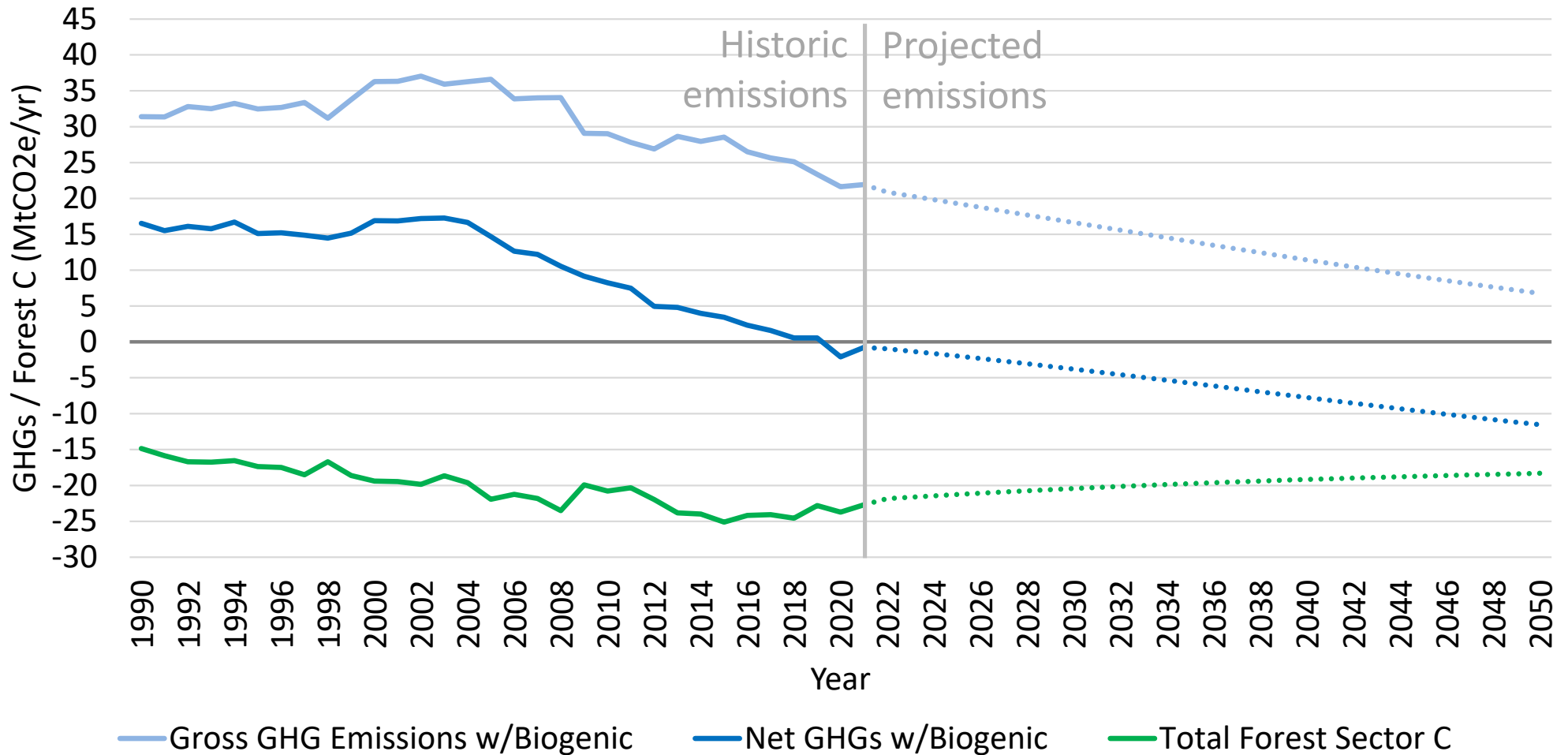


Forest carbon markets (2021)

- Forestry projects with listed carbon offset credits: 24
- Annual average sum: 1.2 MMTCO₂e
- $14.7 - 1.2 = 13.5$ MMTCO₂e



Net GHG emissions timeseries



The data for this figure are accessible on Dr. Adam Daigneault's lab website at the University of Maine at <https://umaine.edu/forestpolicy/models-and-data/>



2021 Summary

- Gross GHG emissions in 2021 were 30% below 1990 levels.
- Maine is approximately 91% of the way toward carbon neutrality.
- CO₂ emissions from fossil fuel combustion in the electric power sector have decreased by 79% since they peaked in 2002.
- Gross GHG emissions per million dollars of state GDP were 59% lower than in 1990. (Maine's economy has grown while GHG emissions have declined.)
- 94% of gross GHG emissions are the result of energy consumption.
- 65% of gross GHG emissions are CO₂ from the combustion of fossil fuels.
- 49% of CO₂ emissions from the combustion of fossil fuels are from the transportation sector.
- The transportation and residential sectors have both the highest consumption of petroleum and the highest emissions of CO₂ from burning fossil fuels.



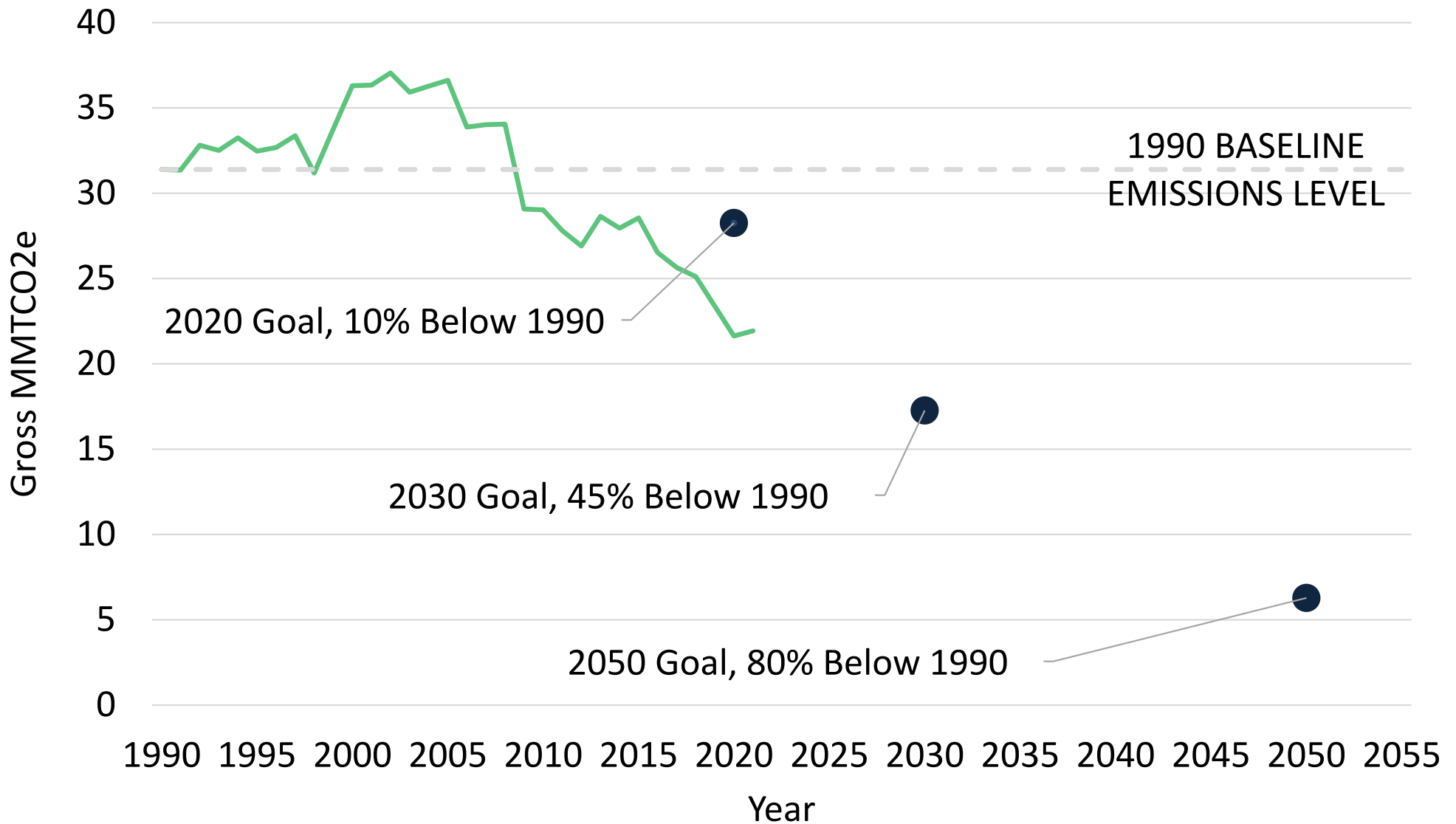
2019-2021 Highlights

- 6% Reduction in gross GHG emissions
- 0% reduction in CO₂ from the combustion of fossil fuels

- Energy sector emissions
 - 57% increase in electric power
 - 3% reduction in commercial
 - 1% change in transportation
 - 13% reduction in residential
 - 25% reduction in industrial
- Energy consumption
 - 24% increase in natural gas
 - 28% decrease in hydropower
 - 19% decrease in wood
 - 2% decrease in petroleum
 - 206% increase in solar power



Gross GHG emissions with goals





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