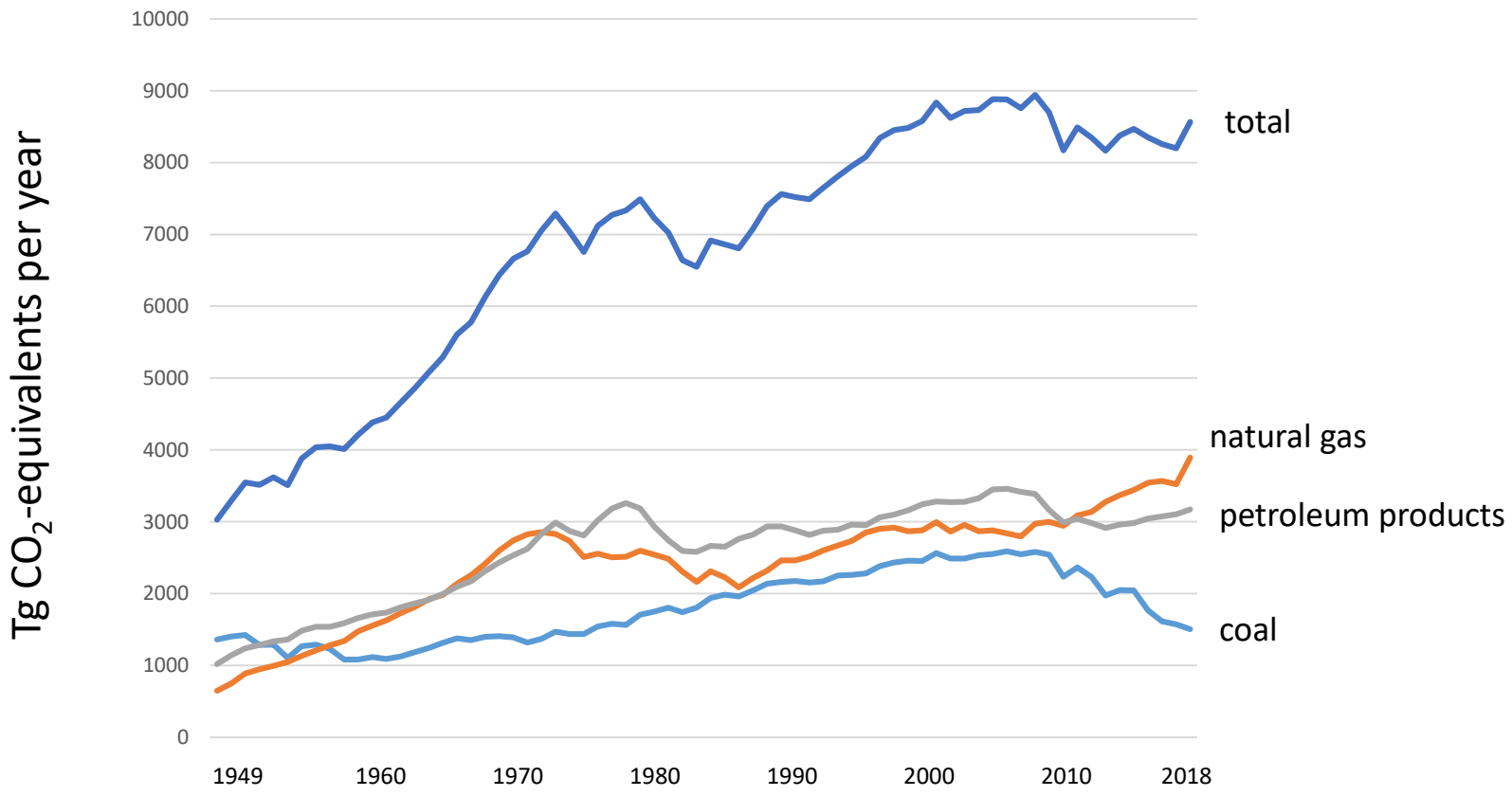
US national greenhouse gas emissions from use of fossil fuels, 1949 to 2018 (sum of carbon dioxide and methane emissions)



R. Howarth, 9/23/19, using emission factors from Howarth manuscript submitted for special journal issue for the 8th International Symposium on Non-CO2 Greenhouse Gases; GWP is 20-yr IPCC value of 86

Figure shows the sum of carbon dioxide and methane emissions for all fossil fuels and by type of fossil fuel in the United States from 1949 to 2019. Energy data are from the US DOE EIA (https://www.eia.gov/totalenergy/data/monthly/, downloaded 23 Sept 2019). Carbon dioxide emission factors are from Hayhoe et al. (2002): 92 g CO_2 MJ^{-1} for coal, 73 g CO_2 MJ^{-1} for petroleum products, and 55 g CO_2 MJ^{-1} for natural gas. The methane emission factor for coal is 0.185 g CH_4 MJ^{-1} (based on Table 2 of IPCC 1996); this value is quite good for 1990. The methane emission factor for petroleum products is 0.093 g CH_4 MJ^{-1} (NETL 2008, as used in Howarth et al. 2011); this value is reasonable for the 20th Century but may underestimate emissions associated with shale oil development over the past decade (Howarth 2019). And the methane emission factor for natural gas is 3.5%, as estimated in Howarth (2019); this value is robust for the past decade and probably well represents emissions in the late 20th Century as well (Howarth 2014). Methane emissions are converted to carbon dioxide equivalents using a 20-year global warming potential of 86 (IPCC 2013), following the guidance in the Climate Leadership and Community Protection Act passed by New York State in July 2019.

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R. Howarth, 9/23/19, using emission factors from Howarth manuscript submitted for special journal issue for the 8th International Symposium on Non-CO2 Greenhouse Gases; GWP is 20-yr IPCC value of 86